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No. 1781

HANDBOOK OF THE 3.8-INCH HOWITZER MATÉRIEL

MODEL OF 1915

WITH INSTRUCTIONS FOR ITS CARE

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(EIGHTEEN PLATES)

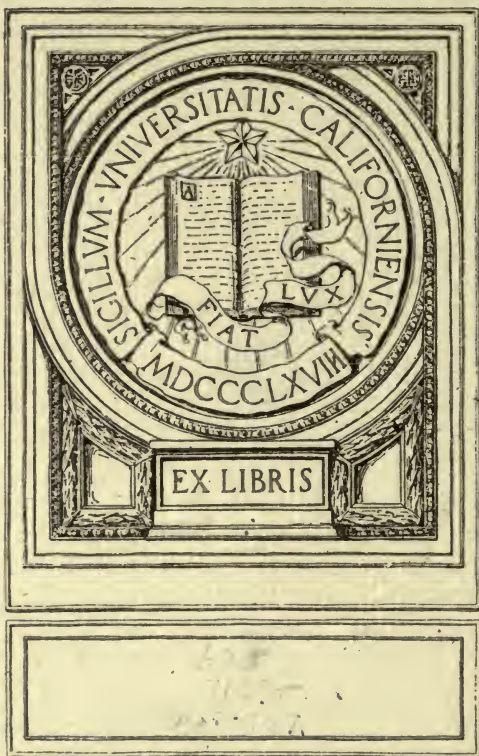
JANUARY 27, 1916



WASHINGTON
GOVERNMENT PRINTING OFFICE

1917

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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, January 27, 1916.

This manual is published for the information and government of the Regular Army and Organized Militia of the United States.

By order of the Secretary of War:

WILLIAM CROZIER,
Brigadier General, Chief of Ordnance.

(3)



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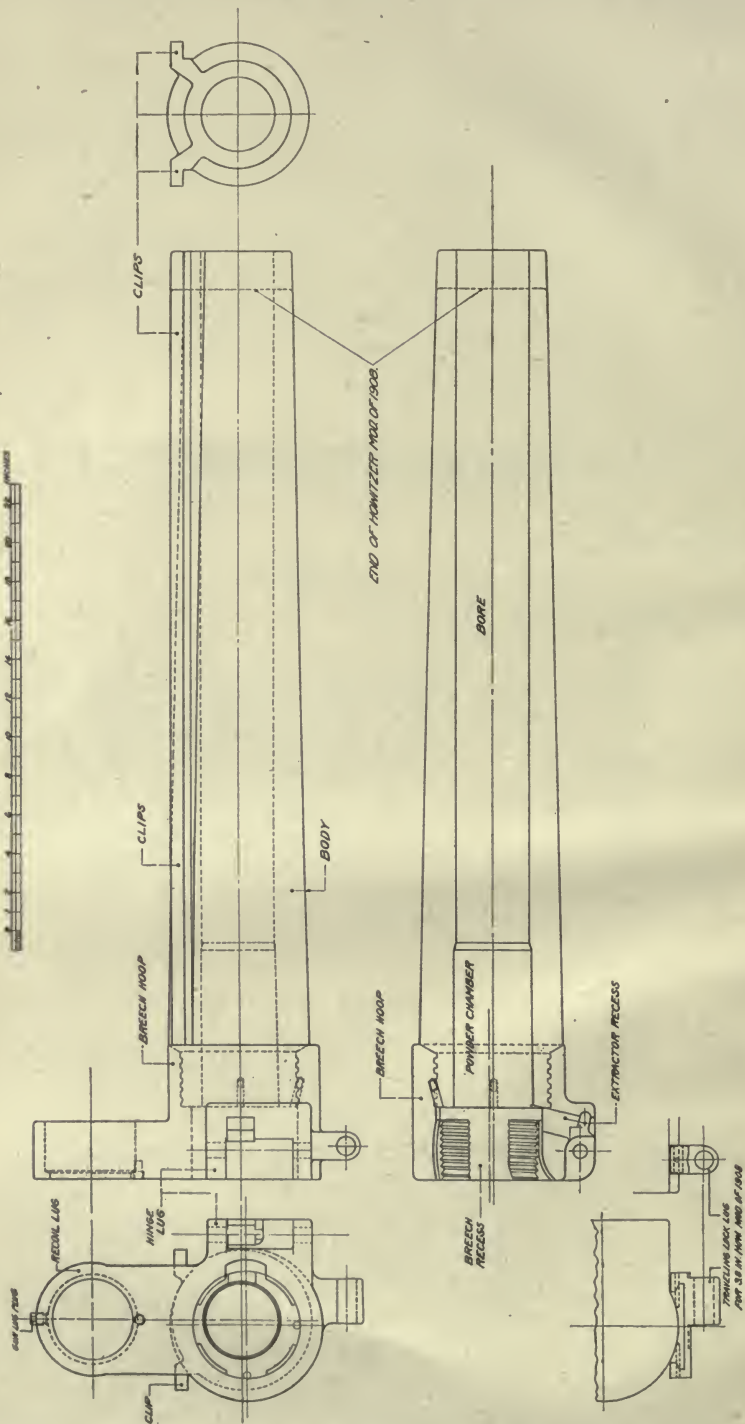
¹ In 1659.

**LIST OF EQUIPMENT PERTAINING TO ONE 3.8-INCH HOWITZER
BATTERY ON WAR FOOTING.**

Num- ber.	Equipment.	Property classifica- tion.	
		Class.	Section.
4	3.8-inch howitzers, model of 1908 or 1908Mr.....	IV	3
4	3.8-inch howitzer carriages, model of 1915.....		
16	3.8-inch howitzer limbers, model of 1915.....		
12	3.8-inch howitzer caissons, model of 1915.....	IV	9
1	Forge limber, model of 1902.....		
1	Battery wagon, model of 1902 or 1902Mr.....		
1	Store limber, model of 1902.....	IV	8
1	Store wagon, model of 1902 or 1902Mr.....		
37	Sets of artillery harness (lead).....		
19	Sets of artillery harness (wheel).....		



3.8 INCH HOWITZER MODEL OF 1908 AND 1908 M1.



HANDBOOK OF THE 3.8-INCH HOWITZER MATÉRIEL, MODEL OF 1915.

THE 3.8-INCH HOWITZERS, MODELS OF 1908 AND 1908 M1.

[Plate I.]

WEIGHTS, DIMENSIONS, ETC.

	Mod. 1908.	1908 M1.
Weight.....pounds..	423	432
Caliber.....inches..	3.8	3.8
Total length.....do...	48.0	50.0
Length of bore.....do...	44.2	46.2
Length of rifled portion of bore.....do...	35.75	37.23
Rifling:		
Number of grooves.....	34	34
Depth of grooves.....inches..	0.03	0.03
Width of grooves.....do...	0.2111	0.2111
Width of lands.....do...	0.14	0.14
Twist, right-hand, uniform one turn in 20 cal.		
Weight of projectile, filled and fuze.....pounds..	30	30
Weight of powder charge.....ounces..	16	16
Weight of cartridge case.....pounds..	3.2	3.2
Capacity of cartridge case.....cubic inches..	70	70
Muzzle velocity.....feet per second..	900	900
Maximum pressure per square inch.....pounds..	18,000	18,000
Range at 45° elevation.....yards..	6,338	6,338

DESCRIPTION.

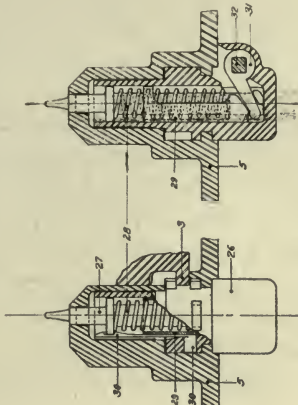
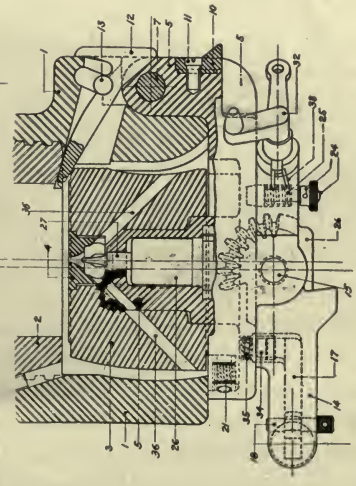
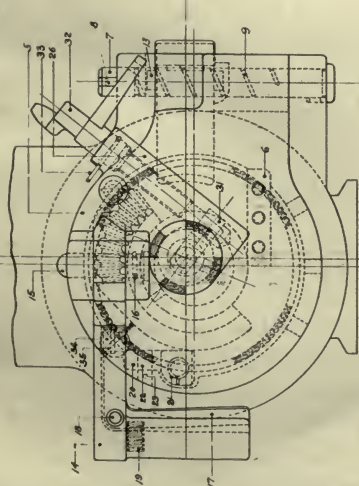
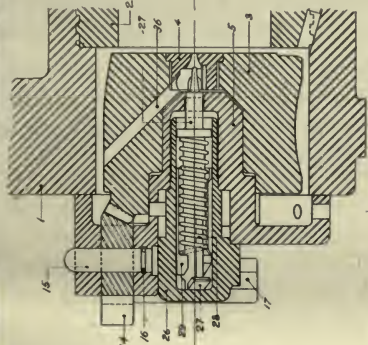
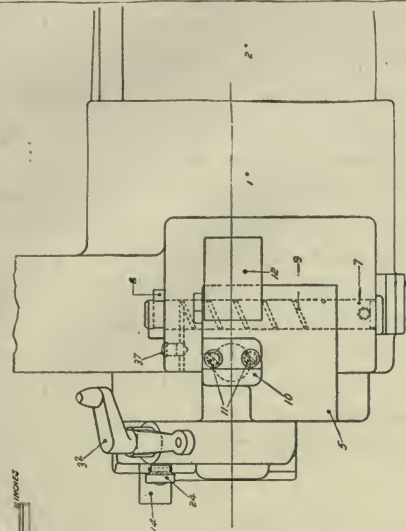
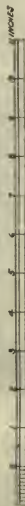
The howitzer is built up of nickel steel, and consists of two parts—the body and the breech hoop. The breech hoop envelops the breech end of the body and projects beyond it to form the breech recess or seat for the breech mechanism. The breech hoop is joined to the breech end of the body by means of screw threads employing six and one-half turns to set it in place, and in addition to being threaded on it is put on with a shrinkage. The breech hoop has a lug at its extreme end which projects upward and forms a point of attachment for the recoil devices. Along the body in the upper right and left hand quadrants are two clips which serve as guide rails. The surfaces of these guide rails are parallel to the bore of the body, and fitting into the recoil guides of the carriage, direct the howitzer during recoil and counter-recoil. By means of these guide rails the weight of the howitzer is transmitted to the carriage. The Model of 1908 M1 has a modified type of traveling lock lug. There is also a difference in the length and weight of the two models.

BREECH MECHANISM.

[Plate II.]

The breechblock is of the interrupted-screw type, and is provided with four threaded and four slotted sectors. The front end of the axial recess in the block for the hub of the block carrier is closed by a bushing. Three vent holes leading from a cavity in the bushing rearwardly through the breechblock permit the escape of gas in case of primer rupture. On a semicircular boss on the rear face of the breechblock are cut gear teeth, in which the gear teeth of the operating lever bevel gear mesh. The lower end of the circular boss on which the gear teeth are cut serve as a stop to limit the rotation of the block in the unlocked position. This lower end of the circular boss comes in contact with a hardened steel stop riveted to the inner face of the block carrier. A radial lug or tooth projects from the inner surface of the circular boss on the breechblock and engages an L-shaped groove cut in the hub of the block carrier, so that when the mechanism is unlocked no relative movement between the breechblock and carrier can take place. In order to maintain this relation between the breechblock and block carrier, a block latch, pivoted on the inner face of the carrier in the upper left-hand quadrant, engages a notch or shoulder cut in the rear face of the block adjacent to the circular hub on which the gear teeth are cut. This latch is so pivoted that as the mechanism is swung free from the howitzer it moves forward sufficiently to engage the notch in the block, and also to cause the forward plane of the latch to project forward of the front face of the block carrier; consequently when the mechanism is swung to the closed position the front face of the latch comes in contact with the rear face of the breech of the howitzer, thus forcing the latch out of the notch in the breechblock back into a recess in the carrier, and on continuing the motion of closing the mechanism the breechblock is free to rotate on the hub of the carrier and engage its threads with those in the howitzer. When the breechblock is in the locked position a lug on the firing-lock case engages the front face of the tooth or lug on the breechblock, locking the breechblock to the carrier. The breechblock is mounted eccentrically in the breech of the howitzer, with reference to the axis of the bore, and is concentrically mounted on a hub on the block carrier, in which the firing-lock case is fitted. The firing lock is eccentrically fitted in the hub of the block carrier, in such a position that the axis of the firing pin is always in line with the bore of the howitzer. The bushing in the front end of the breechblock, through which the firing pin passes, when in the fired position, is fitted eccentrically with reference to the breechblock, and is provided with a cavity of such dimensions that the breechblock is permitted to revolve about the

3.8 INCH HOWITZER MODEL OF 1908 AND 1908 M
BREACH MECHANISM ASSEMBLED



NO	NAME OF PART	NO	NAME OF PART
1	BREACH HOOP	27	WEDGE PIN
2	BREACH BLOCK	28	WEDGE PIN
3	BREACH COVER	29	WEDGE PIN
4	BREACH COVER PIN	30	WEDGE PIN
5	BREACH COVER PIN	31	WEDGE PIN
6	BREACH COVER PIN	32	WEDGE PIN
7	BREACH COVER PIN	33	WEDGE PIN
8	BREACH COVER PIN	34	WEDGE PIN
9	BREACH COVER PIN	35	WEDGE PIN
10	BREACH COVER PIN	36	WEDGE PIN
11	BREACH COVER PIN	37	WEDGE PIN
12	BREACH COVER PIN		
13	BREACH COVER PIN		
14	BREACH COVER PIN		
15	BREACH COVER PIN		
16	BREACH COVER PIN		
17	BREACH COVER PIN		
18	BREACH COVER PIN		
19	BREACH COVER PIN		
20	BREACH COVER PIN		
21	BREACH COVER PIN		
22	BREACH COVER PIN		
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27	BREACH COVER PIN		
28	BREACH COVER PIN		
29	BREACH COVER PIN		
30	BREACH COVER PIN		
31	BREACH COVER PIN		
32	BREACH COVER PIN		
33	BREACH COVER PIN		
34	BREACH COVER PIN		
35	BREACH COVER PIN		
36	BREACH COVER PIN		
37	BREACH COVER PIN		

firing pin, which is fixed in the hub of the block carrier and does not rotate. The point of the firing pin, when at rest, is always within the enlarged cavity in the bushing, and when the block is revolved to the unlocked position the hole in the bushing through which the point of the firing pin passes is moved to one side, due to the eccentric arrangement of the breechblock, thus masking the point of the pin and preventing any possible contact between the firing pin and the primer in the cartridge case when the block is unlocked. The block will be practically locked before any contact between the firing pin and primer can take place. The firing pin is provided with a shoulder a short distance in rear of its forward end, which comes in contact with the rear face of the bushing if an attempt is made to fire the howitzer when the breech is unlocked. This is to prevent any possible blow coming on the point of the firing pin and injuring it.

FIRING MECHANISM.

The firing mechanism belongs to that type known as the continuous-pull mechanism; that is, no cocking of the firing pin is required other than a pull on the lanyard or a downward pressure on the firing handle. This arrangement permits of repeating the blow from the firing pin in case of a misfire as often as desired, without opening the mechanism.

FIRING PIN.

The firing pin is mounted in the firing-lock case and near its front end is provided with a collar which serves to guide the pin and acts as a shoulder for the front end of firing spring. This shoulder also serves as a means for locking the firing pin to the sear until the firing spring has been compressed by the action of the firing mechanism and the sear released. The rear end of the firing pin is rectangular in cross section and is provided with a double lug against which the trigger fork engages at a point between its upper end and its axis. The engagement serves as a means of withdrawing the firing pin to its retracted or normal position, after the pin has been released and forced forward. Opposite the double lug for the trigger fork the firing pin is provided with another and smaller lug, which fits into a slot in the firing-spring sleeve and serves to hold the sleeve in its proper position.

FIRING SPRING.

The firing spring is threaded over the firing pin from the rear end of the pin, and over this is assembled the firing-spring sleeve in such a manner that when it is seated in its proper position the firing spring is put under an initial compression by being compressed between the collar on the front end of the firing pin and a shoulder or seat formed on the inside of the sleeve at its rear end.

SEAR.

The sear, which is in the form of a leaf spring, is seated in a slot in the firing-lock case and is provided with a thickened forward end, into which is cut a notch to engage with a hardened portion of the periphery of the shoulder on the firing pin. Just to the rear of this notch in the sear an inclined surface is provided, upon which the forward end of the firing-spring sleeve acts in its forward motion. After the sleeve has traveled the required distance forward to produce the proper compression in the firing spring, the sear is forced outward, thus releasing the engagement between the sear and the shoulder on the firing pin. On the rear end of the sear a cylindrical projection is formed, which fits into a hole drilled into the firing-lock case. This serves to hold the sear in place.

TRIGGER FORK.

The trigger fork is seated in the rear end of the firing-lock case, is constrained from displacement laterally by the walls of the case, and is mounted on the upper squared end of the trigger shaft. The forked end engages the firing pin and sleeve, and it is seated so that the flat sides of the firing pin pass between the ends of the fork, and the rear face of the fork bears against the front face of the double lug on the firing pin at a point located between the end of the trigger fork and its axis. This point of contact between the firing pin and trigger fork is important, as it helps to maintain the proper operation of the firing pin in its return action after firing. The extreme ends of the trigger fork are made in the form of cylinders, and these ends bear against a flat surface on the rear end of the firing-spring sleeve perpendicular to the axis of the sleeve. The fork does not touch the sleeve at any other point. This is important and is the main element which causes the firing pin to return to its normal position after firing. The firing spring is under a fixed initial compression when at rest and exerts an equal pressure between the collar on the front end of the firing pin and its seat in the rear end of the firing-spring sleeve. The pressure on the firing-pin collar is transmitted to the trigger fork at the bearing between the latter and the double lug on the firing pin, while the pressure on the spring seat in the sleeve is transmitted to the trigger fork at its extreme ends. These two forces are constantly equal and opposite in direction, but have different lever arms with respect to the axis of rotation of the fork. The fork is therefore acted upon by a varying couple, the moment of which is sufficient, when the trigger shaft is released, to rotate the trigger fork to the rear, carrying with it the firing pin through the medium of the double lug on its rear end. This motion continues until the firing-pin collar engages the sear, at which time the spring, sleeve, trigger fork, and firing pin are in their normal positions and the firing mechanism again ready for action.

TRIGGER SHAFT.

The trigger shaft is assembled in a projection which forms a part of the firing-lock case, and is held in place by a wire detent. It has at its lower end a squared portion on which the trigger fork is mounted. At its upper end are two projections, the longer of which is provided with a hole for the attachment of a lanyard, by which the howitzer should be fired until the spade at the end of the trail is sufficiently embedded in the ground to hold the carriage in place. The other projection on the trigger shaft is acted upon by the firing pallet, which is mounted in the firing-handle bracket. The firing pallet is connected by the firing link to the firing shaft, on which is mounted the firing handle. This combination of parts serves as a means for firing the howitzer from a seat on the carriage.

FIRING-LOCK CASE.

The firing-lock case contains the entire firing mechanism and can, if necessary, be replaced, complete, in an instant without opening the breech. It contains the firing pin, firing spring, firing-spring sleeve, sear, trigger fork, and trigger shaft and detent. It is provided with four lugs, by which it is locked in place in the hub of the block carrier, and one lug which is forward of the other four, which engages behind a lug on the breechlock. This lug, together with the other four which lock the casing to the carrier, serves to lock the block and carrier together. The firing-lock casing is held from rotary displacement by a spring catch or locking bolt. This locking bolt is fitted in a projection of the casing and its inner end enters a recess or seat in the rear face of the block carrier.

OPERATING LEVER.

The handle and body of the lever is recessed to receive the lever latch. The inner end of the lever is provided with beveled gear teeth, which mesh with corresponding teeth on the breechblock and serve as a means for opening and closing the mechanism. The lever is seated between two lugs on the block carrier and is held in place by a pivot.

BLOCK CARRIER.

The block carrier is hinged on its right side to the howitzer by means of the hinge pin. It is provided with a central, inwardly-projecting hub, upon which the breechblock is concentrically mounted. The hub is bored out eccentrically to receive the firing-lock case, which is held in place from axial displacement by four lugs formed on the inside of the bore. In the forward end of the central hub a slot is cut, which extends to the rear and terminates in an L. This receives the lug on the breechblock and holds the block from

displacement when the mechanism is open. Two lugs are formed on the rear face of the carrier just above its center. They form a seat for the operating lever. On the inner face in the upper left-hand quadrant a seat and pivot for the block latch is provided. In the lower right-hand quadrant on the inner face a hardened-steel block stop is riveted. This prevents the rotation of the block in the open position. In the lower circumference are drilled three vent-holes for the escape of gas in case of a blowback. A catch for the operating-lever latch is suitably located and screwed to the rear face of the carrier. It is held in place by a small pin driven in from the circumference of the carrier. On the right side of the carrier a projecting pallet is attached, which serves to operate the extractor.

BLOCK LATCH.

The latch serves to prevent rotation of the block to its closed position until it is forced backward by coming in contact with the breech of the howitzer. A recess in the latch contains a spring which presses against the inner face of the carrier, forcing the latch forward into its locking recess in the block when the breech is open. When the block is locked the latch rests against the rear face of the howitzer.

EXTRACTOR.

The extractor is located in the extractor seat. It is operated by the right face of the carrier, the pallet on the latter serving to give it a quick throw at the end of the swing of the carrier in opening the mechanism. The extractor rolls on its forward or convex face and is prevented from being displaced by its trunnions, which slide in grooves formed in the top and bottom of the extractor seat. A lip on the extractor engages the rim of the cartridge case and serves as a means of ejecting it.

OPERATING-LEVER LATCH.

The latch is fitted in a seat in the opening lever and serves to lock the handle from rotation, which in turn prevents rotation of the block. The latch is held in place by a steel pivot, which is so fitted that it is held in place by the lever latch and the action of its spring.

HINGE PIN.

This is a hardened-steel pin ground to fit and is held from displacement by a spring catch fitted to its upper end.

ACTION OF THE BREECH MECHANISM.

To open the breech grasp the operating-lever handle; at the same time compress the lever-latch handle. This releases the latch from the catch on the block carrier. Rotate the operating lever to the

rear. During the first part of this movement (81° – $49'$) the block is rotated and its threads disengaged from those of the howitzer, at which time the stop on the block comes in contact with the stop on the block carrier, and the block latch will drop into its notch in the block at the moment of swinging the carrier from the howitzer. The block is now locked against further rotation in either direction. During a further rotation of the operating lever of about 100° the block and carrier swing about the hinge pin clear of the breech recess, the pallet on the carrier forces the outer end of the extractor lever forward, unseating the cartridge case before the end of the 100° movement and finally ejecting the case from the howitzer. When another round is inserted the rim of the cartridge case comes in contact with the extractor and forces it partly home. In closing the mechanism the movements are simply the reverse of opening; as the block carrier comes in contact with the breech face of the howitzer the block latch is forced rearward, unlocking the block from the carrier. Further rotation of the operating lever rotates the breechblock, causing its threads to engage those of the howitzer. This engagement of threads moves the block forward, due to the pitch of the threads, and firmly seats the cartridge in the howitzer. At the final motion of the operating lever its latch engages the catch on the rear face of the block carrier, locking the block in the closed position. The howitzer is now ready to fire.

FIRING DEVICE.

The firing device consists of a firing-handle bracket (bolted to the cradle of the carriage), firing handle, firing-handle spring, firing-handle plunger, firing-handle hub, handle-return spring, shaft-return spring, firing shaft, firing link, firing pallet, shaft-trip collar, trip latch, trip-latch spring, trip-latch pin, trip-collar pin, trip-latch plunger, and adjusting screw. The bracket has a cylindrical portion, the cylinder having a central diaphragm or partition. In the rear portion of this cylinder is fitted the shaft-return spring, which acts on the firing shaft to return it to its normal position after the sear has been tripped and the howitzer fired. The firing shaft returns to its normal position, no matter whether the operator releases the firing handle or not. In the forward portion of the cylinder the handle-return spring is fitted. This spring is employed to hold the firing handle in a position convenient for firing the howitzer.

The firing handle is mounted loosely on the forward end of the firing shaft and is connected therewith by means of a trip collar and latch. The trip collar is provided with a squared opening which fits over a correspondingly squared end on the forward end of the firing shaft.

The hub of the firing handle is provided with a trip latch so arranged that the latch is in engagement with a notch in the periphery of the trip collar. By this means the firing handle is temporarily made fast to the firing shaft. By a sufficient downward movement of the firing handle the lower end of the trip-latch plunger is caused to come in contact with the adjusting screw, which is suitably located in the firing-handle bracket. This engagement between the lower end of the trip-latch plunger and the adjusting screw forces the plunger upward, thus releasing the trip latch and allowing the firing shaft to return to its original or normal position. The firing handle is arranged so that it can be folded back and out of the way for traveling purposes. The handle is hollow and is provided with a plunger, coil spring, and an adjusting or compression plug, which is screwed in or out by means of a screw driver until the desired compression on the spring is obtained. One end of the plunger bears against a flat surface on the firing-handle hub, and the friction produced by the compression of the spring tends to hold the firing handle in either the folded or open position.

On the rear of the firing shaft is formed a lug which is connected to a lug on the firing pallet by the firing link. Pressing down on the firing handle results as follows: The firing shaft is rotated, the shaft-return and handle-return springs are put under additional stress, the firing link transmits this rotation to the firing pallet, the trigger shaft rotates, which in turn rotates the trigger fork, compressing the firing spring through the medium of the firing-spring sleeve until the front end of the latter trips the sear and releases the firing pin.

TO DISMANTLE THE FIRING MECHANISM.

Take hold of the milled headed locking bolt situated at the lower end of the firing-lock case, pull it to the rear; at the same time revolve the firing-lock case downward about 45° and pull it gently to the rear. This will remove the case with the firing mechanism complete from the howitzer. Press the trigger-shaft detent until it disengages from the notch in the firing-lock case. This will allow the trigger shaft, with its detent, to be withdrawn. Then gently press on the front end of the firing pin, forcing it back into the casing. This will allow the trigger fork to fall out. Then, with one finger placed on the front end of the sear, force it outward; at the same time grasp the front end of the firing pin. Give it a sharp pull. This will remove the firing pin with its spring and sleeve from the casing. Then place the front end of the firing pin against a block of wood, bear down on the firing-spring sleeve until the spring is compressed sufficiently to disengage the slot in the rear end of the sleeve from the small lug on the rear end of the firing pin, slightly turn the sleeve, and then the sleeve can be separated from the spring and pin. By an

unscrewing motion the spring can be removed from the pin. The sear can be removed by gently pressing it in toward the center of the casing.

To assemble, reverse these operations, taking care that before driving too hard on the end of the trigger shaft that the square hole in the trigger fork is in position to receive the tapered end of the trigger shaft. No tools are required for assembling or dismantling this mechanism.

TO DISMANTLE THE BREECH MECHANISM.

Grasp the operating lever and open the mechanism; when the mechanism is open force the block latch out of its seat in the block by pressing it into its seat in the carrier. Take hold of the block and revolve it to the left until it stops; then pull it to the rear, taking care not to drop it. The block latch can now be readily removed. After the firing-lock case has been removed the operating lever can be removed by forcing its pivot down from above by a gentle pressure with the palm of the hand. The lever latch can be removed by pressing in on the latch at a point near its lower end opposite its pivot. The hole in the latch is cut eccentric with reference to the pivot, and a shoulder on the pivot prevents its displacement until the latch is forced in enough to bring the hole concentric with the pivot. When this occurs the pivot can be readily pulled out and the latch removed. To remove the block carrier first remove the hinge-pin catch, force the hinge pin down by hand until it can be caught by the head, and remove it, swinging the carrier back and forth if the pin sticks. The extractor can now be removed from the howitzer.

Reverse these operations for assembling the mechanism. No tools other than the hands are required for dismantling this breech mechanism.

CARE OF THE HOWITZER.

After firing, the bore of the howitzer should be cleaned to remove the residue of smokeless powder, and then oiled. In cleaning, wash the bore with a solution made by dissolving one-half pound of sal soda in 1 gallon of boiling water. After washing with the soda solution wipe perfectly dry, and then oil the bore with a thin coating of the light slushing oil furnished for the purpose. A slush brush for use in oiling the bore is issued by the Ordnance Department.

The breech mechanism should be kept clean and well oiled. It should be dismounted from time to time for examination and oiled when assembled. The spare parts carried in the trail box or in the battery wagon should be well coated with vaseline or heavy oil and each piece then wrapped in paper to prevent the oil from being rubbed off.

AMMUNITION.

Separate loading ammunition with brass case is used in the 3.8-inch howitzer and is made up with either common shrapnel or common steel shell. The ammunition varies in length with the type of projectile used. The ammunition chests of the battery are of sufficient size to take any of the ammunition furnished so that the number of each kind to be carried is a matter of regulation by proper authority.

All ammunition is issued filled and fuzed. The weight of the projectile is 30 pounds, and the total weight of one complete cartridge is about $34\frac{1}{2}$ pounds. The components of this ammunition are the primed cartridge case, diaphragm, propelling charge, and the fuzed projectile.

A cast-iron shell has been designed having the same center of gravity and exterior dimensions as the common steel shell.

A design for a high-explosive shrapnel is being developed with a view to its adoption to supersede the common shrapnel.

THE CARTRIDGE CASE.

[Plate III.]

The cartridge case is a solid drawn brass case 7.34 inches long, having a capacity of 63.37 cubic inches under diaphragm and weighs, with primer, 3.125 pounds. The head of the case has a projecting flange or rim under which the lip of the extractor engages. The center of the head of the cartridge case is bored out to form a seat into which the primer is forced. These primer seats are first mandreled to near the finished dimensions with a tapered steel drift to toughen the metal of the cartridge case contiguous to the primer seat and then reamed to finished size. This toughening is necessary to prevent expansion of the primer seat under the chamber pressure and consequent loose fit of the primer in subsequent firings. The primers are inserted in the case by means of the large primer inserting press to avoid injury to the primer seat or to the operator. Special decapping tools are also issued for use in removing exploded primers from cartridge cases.

The base is stamped with name of gun, initials of place, and year of manufacture, and ammunition lot number.

THE PRIMER.

[Plate III.]

To insure the ignition of smokeless-powder charges in cartridge cases it is necessary that the primers either contain in themselves, in addition to the percussion composition, an auxiliary charge of black powder or that an auxiliary charge of such powder be placed at the rear of the cartridge case to communicate the flame from the percussion primer and thoroughly ignite the smokeless powder. The per-

cussion primer, known as the "110-grain percussion primer," contains an igniting charge of 95 grains of black powder in addition to the essential elements of a percussion primer or cap.

The 110-grain percussion primer is shown in Plate III and consists of a brass case resembling in shape a small-arms cartridge case. The head or rear end of the primer case is counterbored, forming a cup-shaped recess, in which is seated the cap or percussion primer proper. The latter consists of the cup, the anvil, and the percussion composition assembled as shown on Plate III. The percussion composition is known as the "H-42" mixture, and contains the following ingredients:

	Per cent.
Chlorate of potash.....	47.20
Antimony sulphide.....	30.83
Flowers of sulphur.....	21.97

The percussion-cap recess is connected with the interior of the primer case by a small axial vent. The body of the case contains 95 grains of black powder, constituting the rear priming or igniting charge for the smokeless powder propelling charge. This black powder is inserted under a pressure of 2,400 pounds per square inch, and is pressed into the primer body around a central wire, which is then withdrawn, leaving a longitudinal hole the full length of the primer. Eight radial holes are drilled through the primer and the compressed powder, affording 16 vents for the free exit of the black powder flames. After filling the primer, the front end of the primer case is closed by two cardboard wads and waterproofed with shellac. The radial perforations in the body of the primer case are covered by a tinfoil wrapper, shellacked on to retain in the case any loose black powder as well as to exclude all moisture.

In action, the blow of the firing pin explodes the percussion cap, which ignites the black powder, the flames from the latter shoot out through the vents in the primer case and ignite the smokeless-powder charge.

A shorter primer, known as the "saluting primer, percussion," is issued for use in blank cartridges. The percussion elements and dimensions of the seat in the cartridge case for both types of primers are identical. The primer charge of the saluting primer consists of 20 grains of loose rifle powder, held in place by a paper wad shellacked in the mouth of the primer case.

The 20-grain saluting primers are issued in hermetically sealed tin boxes, 25 in a box. The boxes should not be opened nor the cases primed until shortly before they are required for use.

The large primer inserting press is provided for inserting both types of primers. This press should be used and the primers never hammered into their seats in the cartridge case. Special decapping tools are also issued for removing old primer cases from cartridge cases without injury to the latter.

THE POWDER CHARGE.

The powder is a nitrocellulose powder composed of multiperforated (seven perforations) cylindrical grains packed in three raw silk bags to provide for the three zones of fire. The bags are distinguished in the following manner: The bag placed in the bottom of the cartridge case is known as the "inner charge bag" and is stamped "1." The bag in the middle is known as the "middle charge bag" and is stamped "2." The bag at the top directly under the diaphragm is known as the "outer charge bag" and is stamped "3." The total charge varies in different lots of powder, but is approximately 16 ounces. The charge bags are held in place by means of glazed jute or flax twine passed through special screw eyes in the head of the case. The heads of these screw eyes consist of two helical coils in place of the usual ring. In making up the cartridge the twine for the middle charge bag, which is colored with rosaniline, is first passed under the heads of the screw eyes and the ends laid over the edge of the cartridge case. Two pieces of twine are passed through the fabric of the inner charge bag on the front end and tied. The ends are then passed through the hole for the primer, passed under the screw eyes, and brought up outside of the bag; one end of each string is then tied across the top of the bag and the free ends laid over the edge of the case. The middle charge bag is then placed in position and secured by the colored string, which is threaded through the holes in the ends of the handle and tied over the top of the bag. The remaining strings are used to secure the outer charge bag in a similar manner, after which the diaphragm is inserted and secured in place by the soldering strip.

Shrapnel should not be fired for canister effect with inner zone charge and 0 fuze setting, as the personnel of the firing detachment would thereby be endangered, due to a possible rearward movement of the shrapnel case, the case velocity arising from the bursting charge being sometimes greater than the muzzle velocity. For this reason and also for the purpose of securing the greatest and most effective ball velocity, the full charge should always be used when firing for canister effect.

Smokeless powder must not be used for blank charges. For this purpose the Ordnance Department furnishes special powder.

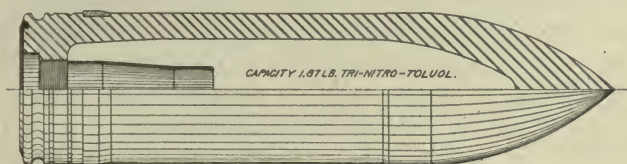
PROJECTILES.

COMMON STEEL SHELL.

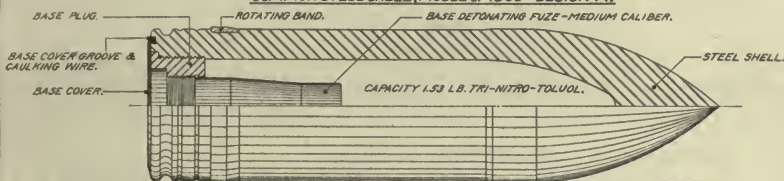
[Plate III.]

The common steel shell is provided with an ogival head struck with a radius of two calibers and is fitted with a copper rotating band forced into an annular groove 1.5 inches from the base.

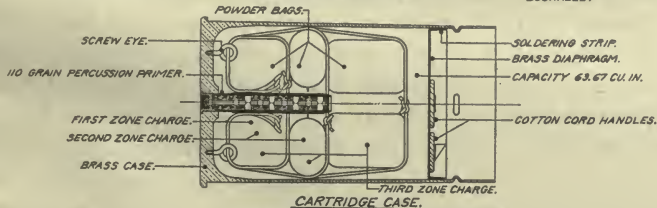
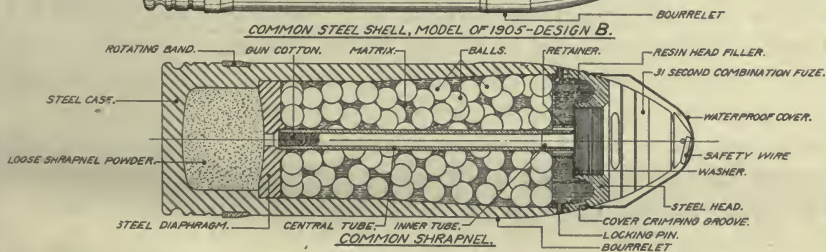
The base of the shell is tapped for a medium caliber base detonating fuze and is fitted with a copper base cover secured in the base cover



COMMON STEEL SHELL, MODEL OF 1905-DESIGN A.



COMMON STEEL SHELL, MODEL OF 1905-DESIGN B.



0 1 2 3 4 5 INCHES.



groove by the calking wire. The base cover consists of a copper cover, lead disk lying between the cover and the projectile, and a lead calking wire. This base cover seals the joint between the fuze and shell against the entrance of propelling powder gases into the shell cavity. Two types of shell are manufactured, known as design A and design B. Design A is the older type. It is 14.7 inches long and contains a bursting charge of 1.87 pounds of trinitrotoluol. It will ultimately be superseded by design B, which is 14.125 inches long and contains a bursting charge of 1.53 pounds of trinitrotoluol. This latter type has a heavier wall and is provided with a base plug, the joint between which and the base of the shell are protected by the base cover. The weight of either type of shell with bursting charge and fuze is 30 pounds.

Shells are always issued filled, fuzed, and base covered.

COMMON SHRAPNEL.

[Plate III.]

The shrapnel is a base-charged common shrapnel fitted with a combination fuze. The case is of forged alloy steel with a solid base. The rotating band is forced into an annular groove cut in the case 1.5 inches from the base. The front or mouth of the case is closed by a steel head, screwed in and tapped to take the service 31-second combination fuze, model of 1907 M. The shrapnel bursting charge is composed of a charge of loose black shrapnel powder (0.33 pound). The bursting charge is contained in chamber formed by the base of the shrapnel case and the diaphragm. The diaphragm supports a brass central tube which extends forward to the fuze, and thus affords a flame channel from the fuze to the bursting charge. At the lower end of the central tube a stopper of dry guncotton is fitted to assist the ignition of the bursting charge and to prevent the loose powder charge from getting into the tube. The shrapnel filling is composed of 369 balls, each approximately 215 grains in weight. The balls are approximately 0.54 inch in diameter. The interstices contain a smoke-producing matrix.

In action the case is not ruptured upon the explosion of the bursting charge, but the diaphragm, shrapnel balls, head, and fuze are expelled from the shrapnel case in much the same way as shot is expelled from a shotgun cartridge.

All shrapnel ammunition is issued fuzed ready for use and provided with a waterproof cover over the fuze to exclude moisture.

FUZE.

COMBINATION FUZE.

These fuzes are point fuzes with combination time and percussion elements for use with shrapnel. They are of the type known as the ring or "dial" fuze, in which the time train is set by turning a gradu-

ated ring which carries part of the time train. These fuzes may be reset as often as desired. The setting should be kept at "S" for safe transportation.

FRANKFORD ARSENAL COMBINATION FUZE, MODEL OF 1907 M.

[Plate IV.]

- (a) Body, bronze.
- (b) Closing cap, brass.
- (b¹) Vents in closing cap.
- (b²) Safety wire.
- (c) Upper time train ring, Tobin bronze.
- (c¹) Washer for time train ring, graduated, felt cloth.
- (d) Time train ring, graduated, Tobin bronze.
- (d¹) Washer for body, felt cloth.
- (d²) Rotating pin, brass.
- (e) Concussion plunger.
- (e¹) Concussion resistance ring, brass.
- (f) Firing pin.
- (g) Vent leading to upper time train.
- (h) Compressed powder pellet.
- (i) Upper time train, compressed powder.
- (j) Compressed powder pellet in vent leading to lower time train.
- (j¹) Compressed powder pellet in lower time train vent.
- (k) Lower time train, compressed powder.
- (l) Brass disk, crimped in place.
- (m) Compressed powder pellet in vent (o).
- (o) Vent leading to magazine.
- (p) Powder magazine.
- (q) Percussion plunger.
- (r) Percussion primer.
- (s) Vents leading from percussion primer to magazine.
- (u) Bottom closing screw, brass.
- (v) Washer for closing screw, muslin.
- (w) Washer for closing screw, brass.

The body (a) of this fuze is machined from a bronze die casting. The time train rings (c) and (d) are turned from hard-rolled bars of Tobin bronze. An annular groove in the shape of a horseshoe is milled in the lower face of each of the time train rings. Meal powder is compressed into these grooves under a heavy pressure, forming a time train.

The time element of this fuze is composed principally of the following parts: The time or concussion plunger (e), the concussion resistance ring (e¹), the firing pin (f), the vent (g) leading to the upper time train, the compressed powder pellet (h), the upper time train (i), the vent (j), the lower time train (k), the compressed powder pellet (m) in the vent (o) leading to the powder magazine (p).

31 SECOND COMBINATION FUZE MODEL OF 1907 M.

FIG. 1.

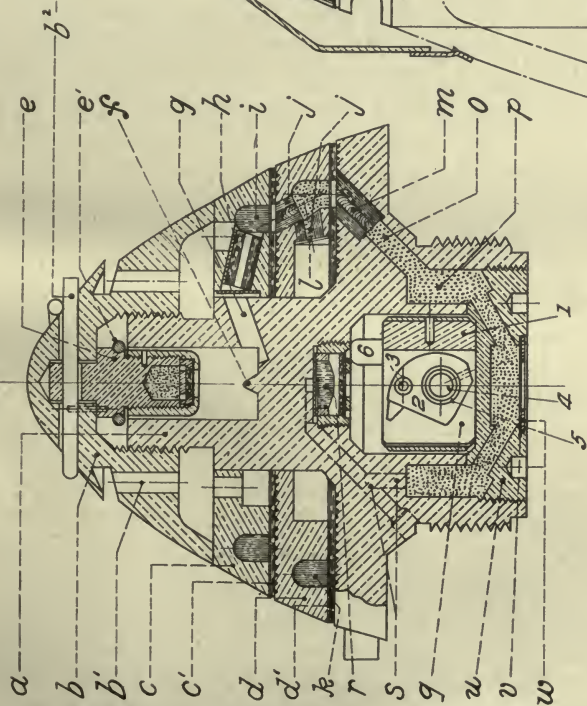
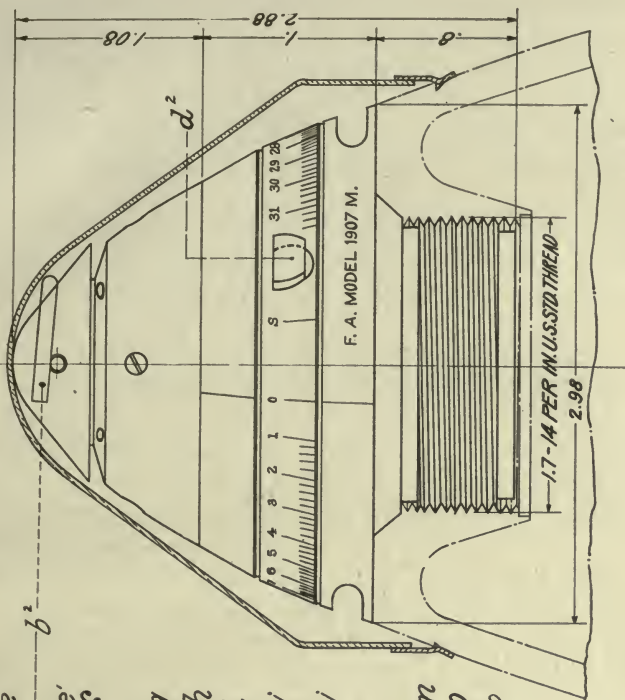


FIG. 2.



F. A. MODEL 1907 M.

2 INCHES.

36-23-69



The plunger (*e*) is cylindrical in shape and contains the percussion composition in a recess at its base. The weight of the plunger rests upon the concussion resistance ring (*e*¹), which prevents the primer from contacting with the firing pin except in firing. At discharge of the howitzer the resistance of the ring is overcome, the plunger slips to the rear, and the primer is exploded by contact with the firing pin.

As stated above, the annular grooves into which the meal powder of the time train is pressed are, in plain view, shaped like a horseshoe, a solid portion or safety being left between the ends of the groove in each ring or disk.

The upper time train ring (*c*) is prevented from rotating by two spline pins, which are halved into the fuze body and the inner circumference of the ring.

The vent (*g*) is drilled through the walls of the concussion plunger chamber, and is exactly opposite a hole in the inner surface of the upper time train leading to the end of the train from which the direction of burning is anticlockwise.

The hole (*j*) is drilled through the upper face of the lower time train ring (*d*) to the end of the lower time train groove, from which the direction of burning is clockwise. The lower time train ring is rotatable and is graduated on its outer edge in a clockwise direction from 0 to 31.6. These divisions each subtend an angle of 10° and after the first division are subdivided into five equal parts. A radial pin (*d*²) is provided in the lower ring for engagement with a notch in the fuze setter for use in setting the fuze. A line on the lower flange of the fuze stock is the datum line for fuze settings. A few fuzes graduated in 29 divisions have also been issued.

The vent (*o*) is drilled through the flange of the fuze stock to the powder magazine (*p*), and leads to the same end of the lower time train as the vent (*j*)—i. e., that end from which the direction of burning is clockwise when the fuze is at its "zero" setting.

The action of the fuze as a time fuze is as follows:

Assume first the zero or canister setting as shown on the figure. At discharge of the howitzer the concussion plunger arms and fires its primer. The flame from the primer passes out through the vent (*g*), igniting the pellet (*h*), the end of the upper time train (*i*), down through the vent (*j*), to the end of the lower time train (*k*), and thence through the vent (*o*) to the magazine (*p*), the flame from which is transmitted to the base charge in the shrapnel. It will be seen that for the zero setting of the fuze the origin of both upper and lower time trains are in juxtaposition. Assume any other setting, say 12 seconds: The vent (*j*) has now changed its position with respect to the vent (*h*), leading to the beginning of the upper time train and the vent (*o*), leading to the powder magazine (*p*), both of which

points are fixed by the angle subtended between the 0 and the 12° setting. The flame now passes out through vent (*g*) and burns along the upper time train in an anticlockwise direction until the vent (*j*) is reached, where it passes down to the beginning of the lower time train and burns back in a clockwise direction to the position of the vent (*o*), whence it is transmitted by the pellet of compressed powder (*m*) to the powder magazine (*p*).

For the 31.6 setting the vent (*j*), leading to the beginning of the lower time train, is opposite the end of the upper time train and the end of the lower time train is opposite the vent (*o*), leading to the powder magazine. It will now be seen that to reach the magazine (*p*) and burst the shrapnel, the entire length of the time train in both rings must be burned.

As already stated, the annular grooves in the lower face of each ring for the powder trains do not form complete circles, a solid portion or safety being left between the ends of the grooves in each. This solid portion is utilized to obtain a setting at which the fuze can not be exploded, known as the "safety point." This point is marked by a line on the outer edge of the movable time train, surmounted by an "S," and is located about halfway between the zero mark and the 31.6 graduation. When this point is brought opposite the line on the lower flange of the fuze body, the vent (*j*) is covered by the solid metal between the ends of the upper train and the vent (*o*), leading to the powder magazine (*p*), is covered by the solid metal between the ends of the lower or movable time train.

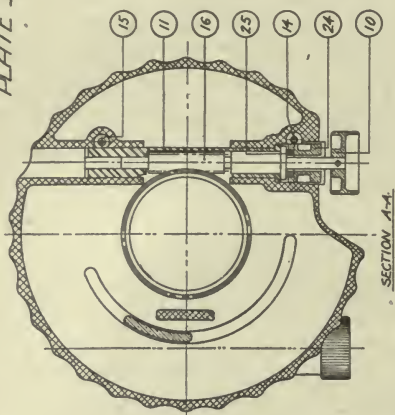
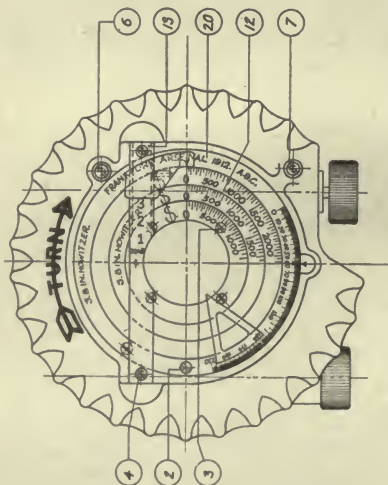
At the safety setting it will be seen that the upper train may burn entirely out in case of accidental firing of the concussion plunger, or in case it may be desired to burst the shrapnel by impact or percussion, without the flame being able to reach the magazine (*p*).

The cloth washers (*c'*) and (*d'*) are glued to the upper face of the graduated time-train ring and to the upper face of the flange on the fuze body. These surfaces are corrugated, as shown, to cause the washers to adhere more strongly. The function of the washers is to make a gas check and to prevent premature action or short-circuiting.

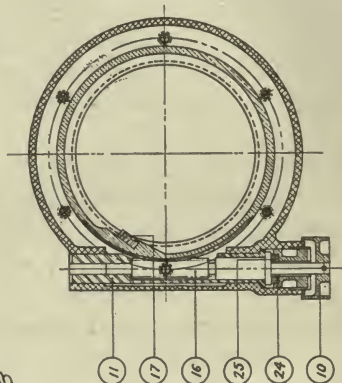
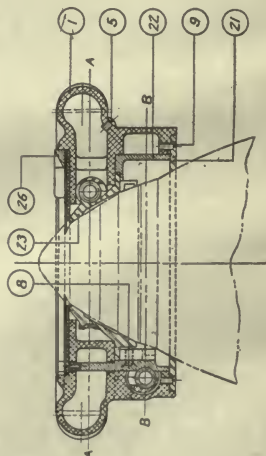
The compressed pellet (*j'*) in the vent leading from the outside to the beginning of the lower time train is to release the pressure of the gases due to the burning train. The gases from both time trains escape into the outer air through the annular spaces shown in the illustration and the vents (*b'*) in the closing cap.

The percussion element of this fuze, as shown in the plate, consists of a centrifugal percussion plunger (*q*) and an ordinary percussion primer (*r*).

The system of vents through the walls of the fuze shown in figure 1 conduct the flame from the percussion primer to the magazine (*p*).



HAND FUZE SETTER
MODEL OF 1913



The bottom closing screw closes the percussion plunger recess and retains the powder in the magazine. The muslin washer (*v*) is coated with shellac and held in place by the brass washer (*w*), over the outer edge of which a projecting lip is crimped.

These fuzes are issued assembled in shrapnel. For transportation in limbers and caissons the fuze should always be set at the safety point and they are so set when packed. Also the safety wire should always be threaded through the concussion plunger during transportation.

The fuze is provided with a waterproof cover of thin brass hermetically sealed. The cover should be stripped off before an attempt is made to set the fuze. The safety wire should be pulled out before the projectile is put in the fuze setter or loaded into the howitzer.

CAUTION.—Whenever a round of shrapnel ammunition has been withdrawn and the safety wire (*b*²) removed from the point of the fuze it should never be replaced in the ammunition chest until the safety wire has been reassembled in the point of the fuze in order to lock the concussion plunger in place.

THE HAND FUZE SETTER.

[Plate V.]

DESCRIPTION.

1. The hand-fuze setter is a device for rapid and accurate setting of the time burning of the fuze for various ranges and heights of burst.

2. For the list of nomenclature see page 30. Plate V shows assembled and sectional views and designation of parts.

3. The hand-fuze setter provided for the 3.8-inch howitzer consists principally of an aluminum case (1) having a serrated rim forming a handle for turning; a range ring (12) mounted on the range ring carrier (23), which is operated by the knob (10) on the worm (16); a corrector scale (20), mounted on the corrector scale support (22), is operated by the knob (10) on the worm (16) and a guide plate (21) which rests on the projectile.

4. A slot is cut in the range ring carrier (23), which engages with the pin on the graduated time-train ring of the fuze. A stop pin (17) is attached to the corrector-scale support (22) and engages with the stop pin of the fuze to limit the motion of the fuze setter.

5. The worm (16) for the range and correction scales are mounted eccentrically in the worm cases (11), which upon rotation provide an adjustment to accommodate for slight variations in manufacture and to take up for wear between the teeth of the worms and worm gears.

6. The worm-adjusting screw (24) provided for each worm (16) has a fiber washer (25) fitted in the end, which bears on the flange of the worm to take up the end motion and to cause sufficient friction to resist accidental turning.

7. Clamp plugs (14 and 15) are provided for locking the adjusting screws and worm cases, these plugs being held in place by screws (6 and 7).

8. The index bar (13), which is attached to the case by two index bar screws (4), carries a range index (26), which slides on the bar and registers the desired zone. The range index is held in position by the index plunger (27) being forced into the notches of the index bar by the index spring (28).

9. The range ring (12) has three scales for zones 1, 2, and 3. The scale for each is graduated from 0 to the range corresponding to the maximum elevation. The least division is 50 yards. The corrector scale (20) has 210 divisions, numbered each 10 divisions to 100, then 120, 150, 170, 190, and 210, graduation marked 60 being the normal position for a suitable height of burst. The corrector scale is used to vary the height of burst of shrapnel and to compensate for errors made in determining the angle of site and variations in the rate of burning of the time train of the fuze.

OPERATION.

First. Set the range index on the index bar to indicate the zone corresponding to the powder charge used.

Second. Turn the knob of the range worm until the required range on range ring registers with the index.

Third. Turn the knob of the corrector worm until the graduated line on the corrector scale, which indicates the desired correction for height of burst, registers with the engraved arrow on the case.

It should be remembered that 60 is the normal position and an increased reading increases the height of burst or shortens the range to point of burst; a decreased reading on the scales decreases the height of burst or increases the range to point of burst.

To set a fuze, first remove the waterproof cap, withdraw the safety wire, place the hand-fuze setter over the fuze and turn until the slot in the range ring carrier engages with the pin on the graduated time train ring of the fuze. The guide plate and the range ring carrier will then bear firmly on the projectile. Then turn the fuze setter clockwise, as indicated by the arrow on the top of the case, until the stop pin attached to the corrector-scale support engages with the fixed stop pin on the fuze and further motion is prevented.

The pointer which is attached to the top of the corrector scale should register with the graduated line on the closing cap of the fuze to indi-

cate when the stop pin (17) of the fuze setter and the fixed stop pin of the fuze are in contact. This pointer was added because the graduated time train ring of the fuze may have a tendency to stick or bind to such an extent as to lead the operator to believe that the stop pin of the fuze setter and the fixed stop pin of the fuze are in contact and thus give a false setting.

Cards for recording the results of tests of the fuze setters are furnished by the Ordnance Department, on which calculated problems are given for inspection, as indicated below.

Hand-fuze setter for 31-second combination fuze—Calculated fuze settings for 3.8-inch howitzer.

Range.	Corrector.	Calculated settings.		
		Zone 1.	Zone 2.	Zone 3.
0	60	0	0	0
1,000	20	8.45	6.65	5.6
1,500	100	9.77	5.48	3.51
2,000	40	.....	11.73	8.42
3,000	150	.....	15.96	7.22
4,500	200	.....	.....	12.6
6,000	90	.....	.....	29.5

To check the fuze setter, set the range ring and corrector scale to the readings given. Set the fuze with the fuze setter and compare the setting of the fuze with the result in the table. Use shrapnel and not a drill cartridge in making this test. When the range index registers with 0 on the range ring and the corrector scale is set at 60, the fuze will be set at 0 and will explode immediately on leaving the howitzer. When setting a fuze to explode on impact or for safe transportation, set the range index at S and the corrector scale at 60. Great care should be exercised in making this setting and to replace the safety wires before transporting.

DISASSEMBLING AND ASSEMBLING.

To disassemble, remove the index bar (13), which is held in place by two index bar screws (4). Take out the four range-ring screws (3) and the two corrector-scale screws (2), then remove the range ring (12) and corrector scale (20). Remove the six guide-plate screws (9) and guide plate (21).

To remove the worm knobs (10) from the worms (16) drive out the taper pins. Loosen the two worm-adjusting clamp screws (7), which release the adjusting screw clamp plugs (14 and 18), then remove the two adjusting screws (24); the two worms (16) can then be removed by turning. The corrector scale support (22) and range ring carrier (23) can then be removed.

To remove the two worm cases (11) loosen the two worm-case clamp screws (6), which releases the clamp plugs (15 and 19) and allows withdrawal. Assemble in reverse order.

ADJUSTMENT.

Backlash or lost motion may appear between the collars of the worms (16) and the fiber washers (25), between the worm teeth of range-ring carrier (23) and the threads of the worm (16), and between the worm teeth of the corrector scale support (22) and the threads of the worm (16).

To remove backlash that appears endwise, loosen the worm-adjusting screw clamp screws (7), which releases the worm-adjusting screw clamp plug (right) (14) or the worm-adjusting screw clamp plug (left) (18); then turn the worm-adjusting screws (24) clockwise with a screw driver until end play is removed and there is sufficient friction to prevent accidental rotation of the worms (16). Should backlash appear between the worm teeth of the range-ring carrier (23) and the threads of the worm (16), or between the worm teeth of the corrector scale support (22) and the threads of the worm (16), it can easily be removed by loosening the worm-case clamp screws (6), which release the worm-case clamp plug (right) (15) or the worm-case clamp plug (left) (19), and then turning the worm case (11) with a screw driver in which the worm (16) is eccentrically mounted in order to bring the worm (16) closer in contact with the worm teeth. The worm-adjusting-screw clamp plug (right) (14), worm-case clamp plug (right) (15), worm-adjusting screw clamp plug (left) (18), or worm-case clamp plug (left) (19) must be firmly clamped by tightening up on their respective screws after adjustment in order to secure the worm-adjusting screws (24) or worm cases (11) against rotation.

NOMENCLATURE.

Illustration No.	Piece-mark.	Name of piece.	Illustration No.	Piece-mark.	Name of piece.
1	55A	Case.	15	54F	Worm case clamp plug (right).
2	55C	Corrector-scale screw.	16	54G	Worm.
3	55C	Range-ring screw.	17	54H	Stop pin.
4	55D	Index-bar screw.	18	54J	Worm-adjusting screw clamp plug (left).
5	55E	Oil-hole screw.	19	54K	Worm-case clamp plug (left).
6	55F	Worm-case clamp screw.	20	54A	Corrector scale.
7	55F	Worm-adjusting screw clamp screw.	21	54HA	Guide plate.
8	55G	Stop-pin screw.	22	54N	Corrector scale support.
9	55H	Guide-plate screw.	23	54P	Range ring carrier.
10	54A	Worm knob.	24	58N	Worm-adjusting screw.
11	54B	Worm case.	25	58P	Washer.
12	54S	Range ring.	26	59C	Range index.
13	54D	Index bar.	27	59D	Index plunger.
14	54E	Worm-adjusting screw clamp plug (right).	28	59F	Index spring.

The nomenclature given above should be used when ordering spare parts.

3.8 howitzer range table—Shell and shrapnel.

OUTER ZONE—M. V. 900 F. S.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Range.	Angle of elevation.	$\Delta \times$ For $\pm \Delta 1'$ elevation.	$\Delta \times$ For $\pm \Delta 10$ F. S. M. V.	$\Delta \times$ For wind M. P. H.	$\Delta \times$ For change of $\pm 1^\circ$ C.	Time of flight.	Drift.	Deflection for 10 miles cross wind.	Angle of departure.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	Values of $\frac{be}{fa}$
Yds.	°	Yds.	Yds.	Yds.	Yds.	Secs.	Mils.	Mils.	°	1 on—	F. S.	Ft.		
100	1 17	4.8	2.2	0	0.2	0.34	0.22	0.06	0 20	163.7	893	1	2.180	0.953
200	1 38	4.8	4.4	0	.3	.68	.44	.12	0 41	81.8	887	3		
300	1 53	4.7	6.5	.1	.5	1.02	.66	.18	1 1	54.6	880	5		
400	2 20	4.7	8.6	.2	.8	1.36	.88	.24	1 23	40.4	873	8		
500	2 42	4.6	10.7	.3	1.2	1.70	1.11	.31	1 45	32.1	867	12	2.176	.955
600	3 4	4.6	12.8	.5	1.7	2.05	1.34	.37	2 7	26.4	861	17		
700	3 26	4.5	14.8	.7	2.3	2.40	1.57	.43	2 29	22.5	855	23		
800	3 48	4.5	16.8	1.0	3.0	2.75	1.81	.49	2 51	19.4	849	30		
900	4 10	4.4	18.8	1.3	3.8	3.11	2.05	.56	3 13	17.1	843	38		
1,000	4 33	4.3	20.7	1.6	4.7	3.47	2.29	.63	3 36	15.2	837	48	2.163	.960
100	4 56	4.3	22.6	2.0	5.7	3.83	2.54	.69	3 59	13.7	831	59		
200	5 19	4.2	24.5	2.4	6.8	4.20	2.79	.75	4 22	12.4	826	71		
300	5 42	4.2	26.4	2.9	8.0	4.57	3.04	.81	4 45	11.3	820	84		
400	6 6	4.1	28.2	3.4	9.3	4.94	3.30	.88	5 9	10.4	815	98		
500	6 30	4.1	30.0	4.0	10.7	5.32	3.56	.95	5 33	9.59	809	113	2.133	.974
600	6 54	4.0	31.7	4.7	12.2	5.70	3.82	1.02	5 57	8.89	803	130		
700	7 19	4.0	33.4	5.4	13.8	6.08	4.09	1.09	6 22	8.26	798	148		
800	7 44	3.9	35.1	6.2	15.5	6.47	4.36	1.16	6 47	7.72	793	168		
900	8 9	3.9	36.7	7.0	17.3	6.86	4.64	1.23	7 12	7.22	787	189		
2,000	8 35	3.8	38.3	7.9	19.2	7.25	4.92	1.30	7 38	6.79	782	211	2.099	.990
100	9 1	3.8	39.9	8.8	21.2	7.65	5.21	1.37	8 4	6.39	777	235		
200	9 28	3.7	41.4	9.7	23.3	8.05	5.50	1.44	8 31	6.03	771	260		
300	9 55	3.7	42.9	10.7	25.5	8.46	5.80	1.51	8 58	5.70	766	287		
400	10 22	3.6	44.3	11.8	27.8	8.87	6.10	1.58	9 25	5.40	761	316	2.064	1.007
500	10 50	3.6	45.7	12.9	30.2	9.29	6.41	1.65	9 53	5.11	755	347		
600	11 18	3.5	47.1	14.1	32.6	9.71	6.72	1.72	10 21	4.85	750	380		
700	11 47	3.4	48.4	15.4	35.1	10.14	7.04	1.80	10 50	4.61	745	414		
800	12 16	3.4	49.7	16.8	37.7	10.57	7.37	1.88	11 19	4.38	740	450		
900	12 46	3.3	51.0	18.3	40.4	11.01	7.71	1.96	11 49	4.17	735	488		
3,000	13 17	3.2	52.2	19.9	43.2	11.46	8.06	2.04	12 20	3.97	730	528	2.030	1.024
100	13 48	3.2	53.4	21.6	46.1	11.92	8.42	2.12	12 51	3.78	725	571		
200	14 20	3.1	54.6	23.4	49.1	12.38	8.79	2.20	13 23	3.61	720	616		
300	14 52	3.0	55.8	25.4	52.2	12.85	9.16	2.28	13 55	3.45	715	664		
400	15 25	3.0	56.9	27.5	55.4	13.33	9.54	2.37	14 28	3.30	710	715		
500	15 59	2.9	58.0	29.7	58.7	13.81	9.93	2.46	15 2	3.15	706	769	1.998	1.040
600	16 34	2.8	59.1	32.0	62.1	14.30	10.33	2.55	15 37	3.01	702	826		
700	17 9	2.7	60.2	34.5	65.6	14.80	10.75	2.64	16 12	2.89	698	885		
800	17 45	2.6	61.2	37.1	69.2	15.31	11.19	2.73	16 48	2.76	694	947		
900	18 22	2.6	62.2	39.8	72.9	15.83	11.64	2.82	17 25	2.64	690	1,012		
4,000	19 0	2.5	63.2	42.7	76.7	16.36	12.11	2.91	18 3	2.53	686	1,080	1.970	1.055
100	19 39	2.4	64.1	45.7	80.6	16.90	12.60	3.00	18 42	2.42	682	1,152		
200	20 19	2.3	65.0	48.7	84.6	17.45	13.11	3.10	19 22	2.32	678	1,228		
300	21 1	2.3	65.9	51.9	88.7	18.02	13.64	3.20	20 4	2.22	674	1,309		
400	21 44	2.2	66.7	55.2	92.9	18.60	14.19	3.30	20 47	2.13	671	1,395		
500	22 29	2.1	67.5	58.6	97.2	19.20	14.76	3.40	21 32	2.04	668	1,487	1.943	1.069
600	23 15	2.0	68.3	62.1	101.5	19.81	15.36	3.50	22 18	1.95	665	1,585		
700	24 3	1.9	69.0	65.8	105.9	20.44	16.00	3.60	23 6	1.86	662	1,690		
800	24 53	1.9	69.7	69.7	110.4	21.09	16.68	3.70	23 56	1.78	659	1,802		
900	25 48	1.8	70.4	73.9	115.0	21.76	17.41	3.81	24 49	1.70	657	1,927		
5,000	26 42	1.7	71.1	78.3	119.7	22.46	18.21	3.93	25 45	1.62	655	2,051	1.918	1.083
100	27 41	1.6	71.7	83.0	124.5	23.19	19.08	4.06	26 44	1.55	653	2,190		
200	28 43	1.5	72.3	88.0	129.5	23.96	20.03	4.20	27 46	1.47	651	2,340		
300	29 49	1.4	72.9	93.4	134.6	24.78	21.07	4.35	28 52	1.40	650	2,503		
400	31 0	1.3	73.4	99.3	139.8	25.67	22.21	4.51	30 3	1.33	650	2,682		
500	32 18	1.2	73.9	105.9	145.1	26.65	23.47	4.69	31 21	1.25	650	2,883	1.894	1.097
600	33 45	1.1	74.4	113.4	150.5	27.74	24.90	4.89	32 48	1.17	651	3,115		
700	35 24	.9	74.9	122.1	156.0	28.97	26.61	5.12	34 27	1.09	652	3,392		
800	37 19	.7	75.3	132.6	161.6	30.39	28.84	5.39	36 22	1.01	655	3,734		
900	40 0	.4	75.7	146.0	167.3	32.10	32.12	5.72	39 3	.918	659	4,168	1.876	1.107

3.8 howitzer range table—Shell and shrapnel.

MIDDLE ZONE—M. V. 620 F. S.

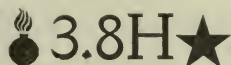
1	2	2	4	5	6	7	8	9	10	11	12	13	14	15
Range.	Angle of elevation.	$\Delta \times$ For $\pm 1'$ elevation.	$\Delta \times$ For ± 10 F. S. M. V.	$\Delta \times$ For wind M. P. H.	$\Delta \times$ For change of $\pm \frac{1}{2}$ C.	Time of flight.	Drift.	Deflection for 10 miles cross wind.	Angle of departure.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	Values of $\frac{pe}{fa}$
<i>Yds.</i>	$^{\circ}$ $'$	<i>Yds.</i>	<i>Yds.</i>	<i>Yds.</i>	<i>Yds.</i>	<i>Secs.</i>	<i>Mils.</i>	<i>Mils.</i>	$^{\circ}$ $'$	<i>1 on—</i>	<i>F. S.</i>	<i>Ft.</i>		
100	1 41	2.2	3.2	0.1	0.3	0.49	0.46	0.11	0 44	76.4	613	3	1.495	1.390
200	2 23	2.2	6.4	.2	.6	.98	.92	.23	1 26	38.2	607	7		
300	3 8	2.2	9.6	.4	1.0	1.48	1.39	.35	2 11	25.3	601	12		
400	3 54	2.2	12.8	.6	1.4	1.98	1.87	.47	2 57	18.8	595	18		
500	4 41	2.1	16.0	.8	2.0	2.49	2.36	.59	3 44	14.9	590	26	1.479	1.405
600	5 29	2.1	19.1	1.1	2.6	3.00	2.86	.71	4 32	12.2	584	36		
700	6 17	2.1	22.2	1.5	3.4	3.52	3.38	.83	5 20	10.3	578	49		
800	7 6	2.0	25.3	2.0	4.2	4.05	3.91	.96	6 9	8.89	573	65		
900	7 55	2.0	28.3	2.5	5.1	4.59	4.45	1.09	6 58	7.77	568	84		
1,000	8 45	2.0	31.3	3.2	6.1	5.14	5.00	1.22	7 48	6.87	563	106	1.460	1.423
100	9 36	1.9	34.3	4.0	7.3	5.69	5.57	1.35	8 39	6.13	558	131		
200	10 29	1.9	37.3	4.9	8.6	6.25	6.16	1.48	9 32	5.52	552	159		
300	11 23	1.8	40.2	5.9	10.0	6.82	6.77	1.61	10 26	4.99	547	190		
400	12 19	1.8	43.1	7.1	11.5	7.40	7.40	1.74	11 22	4.54	542	224		
500	13 17	1.7	46.0	8.4	13.1	8.00	8.05	1.88	12 20	4.15	537	261	1.445	1.438
600	14 17	1.7	48.9	9.8	15.9	8.61	8.73	2.02	13 20	3.80	532	301		
700	15 18	1.6	51.7	11.4	17.8	9.24	9.44	2.17	14 21	3.50	527	345		
800	16 21	1.6	54.5	13.1	19.9	9.88	10.18	2.32	15 24	3.22	523	393		
900	17 26	1.5	57.3	15.0	22.2	10.54	10.96	2.47	16 29	2.97	519	446		
2,000	18 33	1.5	60.0	17.4	24.7	11.22	11.78	2.63	17 36	2.75	515	505	1.434	1.449
100	19 43	1.4	62.7	19.1	27.4	11.92	12.65	2.79	18 46	2.55	511	568		
200	20 57	1.4	65.4	21.9	30.3	12.65	13.58	2.96	20 0	2.36	508	639		
300	22 15	1.3	68.1	24.6	33.3	13.41	14.58	3.13	21 18	2.19	505	719		
400	23 38	1.2	70.7	27.6	36.3	14.21	15.67	3.32	22 41	2.03	502	809		
500	25 8	1.1	73.3	30.9	39.4	15.06	16.88	3.51	24 11	1.88	500	911	1.421	1.462
600	26 46	1.0	75.9	34.6	42.5	15.97	18.25	3.72	25 49	1.73	498	1,007		
700	28 33	.9	78.4	38.8	46.7	16.95	19.83	3.95	27 36	1.59	496	1,159		
800	30 31	.8	80.9	43.6	49.1	18.00	21.68	4.21	29 34	1.46	495	1,311		
900	32 44	.7	83.4	49.1	52.7	19.20	23.89	4.51	31 47	1.33	494	1,490		
3,000	35 21	.5	85.9	55.4	56.5	20.58	26.63	4.86	34 24	1.20	493	1,709	1.404	1.480
100	38 49	.3	88.4	62.6	60.2	22.35	30.60	5.28	37 52	1.06	492	1,993		
123	40 0	.3	90.4	71.0	63.2	22.86	32.10	5.37	39 23	1.02	491	2,112	1.403	1.481

INNER ZONE—M. V. 454 F. S.

1	2	2	4	5	6	7	8	9	10	11	12	13	14	15
Range.	Angle of elevation.	$\Delta \times$ For $\pm 1'$ elevation.	$\Delta \times$ For ± 10 F. S. M. V.	$\Delta \times$ For wind M. P. H.	$\Delta \times$ For change of $\pm \frac{1}{2}$ C.	Time of flight.	Drift.	Deflection for 10 miles cross wind.	Angle of departure.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	Values of $\frac{pe}{fa}$
<i>Yds.</i>	$^{\circ}$ $'$	<i>Yds.</i>	<i>Yds.</i>	<i>Yds.</i>	<i>Yds.</i>	<i>Secs.</i>	<i>Mils.</i>	<i>Mils.</i>	$^{\circ}$ $'$	<i>1 on—</i>	<i>F. S.</i>	<i>Ft.</i>		
100	2 28	1.2	4.2	.0.1	.0.3	0.67	0.80	0.16	1 21	41.4	449	7	1.410	1.474
200	3 41	1.1	8.4	.2	.6	1.34	1.70	.32	2 44	20.4	444	16		
300	5 5	1.1	12.6	.4	1.0	2.00	2.60	.48	4 8	13.5	440	27		
400	6 30	1.1	16.8	.6	1.5	2.71	3.54	.66	5 33	10.0	436	40		
500	7 57	1.1	20.9	1.0	2.1	3.41	4.49	.83	7 0	7.90	432	56	1.398	1.486
600	9 26	1.0	25.0	1.4	2.8	4.10	5.49	1.00	8 29	6.46	428	75		
700	10 58	1.0	29.0	2.0	3.7	4.85	6.54	1.18	10 1	5.41	424	98		
800	12 34	1.0	33.0	2.8	4.7	5.60	7.64	1.37	11 37	4.62	420	126		
900	14 14	1.0	37.0	3.8	5.8	6.38	8.79	1.56	13 17	3.99	416	162		
1,000	15 59	.9	40.9	5.0	7.0	7.19	9.99	1.76	15 2	3.48	412	206	1.382	1.503
100	17 50	.9	44.8	6.4	8.3	8.03	11.29	1.97	16 53	3.05	408	258		
200	19 48	.8	48.6	8.0	9.8	8.91	12.69	2.90	18 51	2.69	405	319		
300	21 54	.8	52.3	9.9	11.5	9.84	14.24	2.44	20 57	2.38	402	390		
400	24 9	.7	55.9	12.2	13.3	10.83	16.09	2.70	23 12	2.11	400	474		
500	26 35	.6	59.5	15.0	15.2	11.89	18.14	2.99	25 38	1.88	398	574	1.370	1.517
600	29 19	.5	63.0	18.4	17.2	13.04	20.64	3.31	28 22	1.66	397	693		
700	32 41	.4	66.4	22.4	19.4	14.40	23.80	3.67	31 44	1.44	396	834		
800	37 27	.3	70.8	27.0	21.7	16.32	29.00	4.07	36 30	1.20	395	1,039		
1,836	40 0	.2	71.0	29.0	22.0	17.19	32.10	4.23	39 3	1.09	394	1,188	1.361	1.527

MARKING ON AMMUNITION PACKING BOXES.

Both ends and sides of the box are marked with conspicuous characters to facilitate the rapid identification of the ammunition contained therein. The conspicuous marking consists of the following symbols:



The shell and flame are always in red for mobile artillery ammunition. The numeral "3.8" refers to the caliber; and the letter "H" differentiates ammunition for the 3.8-inch howitzer from ammunition for the 3.8-inch gun.

For common shrapnel the numerals 3.8 and the letter H are stenciled in yellow, while for high explosive shrapnel these characters are stenciled in red.

For high explosive shell, the characters 3.8 H are all stenciled in black.

The star when present in the conspicuous marking indicates that the projectiles are provided with tracers. A red star indicates a night tracer and a black star a day tracer.

In addition to the conspicuous marking the quantity and type of ammunition are indicated without symbols by the marking "2-3.8 com. steel shell and loaded cartridge cases for howitzer," so that in case one is not familiar with the conspicuous marking system he can immediately ascertain the key by this additional marking. Similarly, the word "tracer" is added in amplification of the star symbol. Also on both ends of the box the "lot," followed by a number, appears. This refers to the ammunition lot, and in case of any trouble arising with regard to the functioning of the ammunition this lot number should be quoted in the report.

On the sides of the box similar markings are found accompanied by a pictorially stenciled symbol indicating the type of the projectile, the tracer, and the fact that the ammunition is unfixed. For blank ammunition when packed assembled the numerals "3.8" and the letter "H" are in blue.

DRILL CARTRIDGE.

The "drill cartridge" is a dummy cartridge of the size and approximate weight of the service ammunition, and is used for drilling cannoneers in the use of the howitzer. It consists of a bronze case into which are placed three maple blocks to represent powder bags. The block representing the powder bag for zone 1 is permanently attached to the case. The blocks representing the powder bags for zones 2 and 3 have leather handles by which they can be lifted. When the

blocks are inserted, the bronze body is attached to the case by the bayonet joints and locked in place by the stop lock. Fitted at the point of the body is a dummy fuze the same as the service 31 second combination fuze, except that it has no live elements. This arrangement is for the instruction of the cannoneers in fuze setting.

MISFIRES AND HANGFIRES.

Misfires and hangfires are of rare occurrence. In case of the failure of a cartridge to fire when the trigger is pulled, the pull should be repeated without opening the breach. The breechblock *should not be opened* until after the expiration of at least one minute from the time that the trigger is last pulled.

Lack of complete rotation of the breechblock, improper assembling of the operating lever, and the incorrect adjustment of the adjusting screw are the most usual causes of misfires, although occasionally due to defective primers or to a weakened firing spring.

ALLOWANCE OF AMMUNITION.

Shell and shrapnel ammunition is issued by the Ordnance Department in moisture-proof zinc-lined wooden packing boxes, two rounds per box.

The annual allowance of ammunition for the instruction of field artillery is prescribed from time to time in War Department orders.

BLANK AMMUNITION.

Blank metallic ammunition consists of the following components: A brass cartridge case, a percussion primer, a charge of black powder, and a tight-fitting felt wad.

THE CARTRIDGE CASE.

The cartridge case for blank ammunition is identical with the service cartridge case.

Cartridge cases that have become deformed in service should be cleaned and turned into the posts or arsenals designated in current orders for resizing and reforming.

THE PRIMER.

The saluting primer (percussion) is used in the preparation of blank metallic ammunition for 3.8-inch howitzer. The primer should be a tight fit in the primer seat in the cartridge case, and must be pressed into place with the primer-inserting press provided for the purpose and not hammered in. No primer should be used that is not a tight fit in its seat in the case.

Cartridge cases should be primed just before the insertion of the propelling powder charge, and under no circumstances will primers be inserted after the powder charge has been inserted.

Primers are issued in hermetically sealed tin boxes, which should not be broken open until the primers are to be used, as they deteriorate when exposed to atmospheric influences.

THE CHARGE.

The charge to be used in the preparation of blank metallic ammunition for 3.8-inch howitzer is 1 pound 15 ounces of black saluting powder.

PREPARATION OF BLANK METALLIC AMMUNITION.

Blank metallic ammunition will be assembled at posts or in the field under the personal supervision of a commissioned officer, who will be held responsible that it is prepared in the manner prescribed in the annual target practice orders.

For this purpose there are issued cartridge cases, saluting powder in bulk, tight-fitting felt wads, nonacid paint, primers, and reloading and cleaning outfits.

Before assembling the cartridge cases should be carefully inspected to see that they are in sound condition and thoroughly clean and dry. They should also be tested by trying them in the howitzer to determine whether they have become deformed. Any cases that do not readily enter the chamber or that are otherwise seriously deformed should be laid aside for resizing. After inspecting the cartridge cases the blank ammunition should be prepared as follows:

- (a) Insert the primer with the primer-inserting press.
- (b) Pour into the cartridge case the proper weight of powder and shake it down well, being careful not to strike the primer in so doing.
- (c) Insert the felt wad and press it down hard until it rests squarely on the powder charge.
- (d) Give the upper surface of the felt wad and the inside of the cartridge case just above the wad a good coat of the nonacid paint furnished for the purpose, using a brush, and allowing the case to stand until this coat is dry. Then apply another coat of paint as described. The object of using this paint, which is strongly adhesive, is to thoroughly seal the joint between the wad and the case and to prevent any powder grains from leaking out, and at the same time to firmly hold the wad in place.

PRECAUTIONS TO BE OBSERVED.

Firings with blank metallic ammunition will be greatly facilitated by a careful observance of the following:

Before all firings a careful examination should be made of the assembled ammunition to see that the felt wads have not become displaced or the cartridge cases dented or deformed by careless

handling. If the cartridge cases have been properly resized and are clean, no difficulty should be experienced in inserting them in the howitzer, provided the chamber of the latter is clean. The continued insertion of cartridge cases that are not clean causes an accumulation in the howitzer chamber, which may make the insertion of subsequent ammunition difficult or impossible.

In firing blank ammunition the howitzer chamber will be sponged after each shot with a damp sponge, to extinguish sparks and to remove powder residue resulting from the previous round before the insertion of another charge, as prescribed in the annual target practice orders. Care will be taken that the sponges are not worn and that they fit the chamber closely. The interval between shots in firing blank ammunition should be sufficient to allow thorough sponging of the chamber and examination to ascertain that all sparks have been extinguished.

Wads for the preparation of blank metallic ammunition are made to fit tightly in the cartridge case. No wads should be used that are not a tight fit in the case.

CARE OF CARTRIDGE CASES.

As soon after firing as practicable the fired primer should be removed from the cartridge case by means of the decapping tool furnished with the reloading outfit. The case should be thoroughly washed in a strong solution of lye or soft soap to remove all powder residue. It should then be thoroughly dried.

If the cartridge cases are carefully cleaned and washed immediately after firing, not only will less labor be required but the life of the cases will be prolonged.

A good solution for washing cartridge cases may be prepared as follows:

- 1 gallon of water.
- 2½ ounces of soft soap.
- 5½ ounces of soda.

The mixture should be boiled and stirred until the ingredients are entirely dissolved.

In washing cartridge cases this solution should be used hot and in sufficient quantity to completely immerse the cases.

Primers that misfire should be turned in with the cases to the ordnance establishment prescribed in the target practice orders.

Resizing cartridge cases.—The resizing of 3.8-inch howitzer cartridge cases that have become deformed in service is done at Frankford Arsenal, Philadelphia, Pa., and at such other establishments as may be designated in orders.

THE RELOADING AND CLEANING OUTFIT.

This outfit consists of the following parts and is furnished to each post where a saluting gun or battery is kept:

Large primer inserting press.

Bushing.

Saluting powder measure.

Decapping tool with guide.

Cleaning brush.

Hammer, bronze.

Case holder.

Case-holder stand.

Storage chest.

The primer inserting presses are standard for all guns and howitzers using metal cartridge cases, there being two sizes, one size for cartridge cases for 1-pounder to 3-inch, inclusive, and one size for 3-inch guns, model of 1903, to 6-inch, inclusive. The bushings are furnished to suit the size of the cartridge case that is to be reprimed, one bushing for each different size of case.

The case-holder stand is the same for all cases. The case holder varies with the size of the case.

The decapping tool and the case holder are used for removing fired primers. The decapping tool varies in length with the size of the cartridge case to be decapped. A light blow on the rod with a piece of wood or bronze hammer generally removes the primer.

A powder measure to suit the saluting charge for each caliber of gun and howitzer is furnished and when level full holds the required charge. Each powder measure is plainly marked on the base for the caliber of the gun or howitzer for which it is intended.

The cleaning brush is furnished for cleaning the cartridge cases after they have been used and should be ordered to suit the size of case for which intended.

TARGETS.

The description and allowance of targets and accessories for mobile artillery are given in Ordnance Office Pamphlet, Form No. 1994, "Mobile Artillery Targets and Accessories."

THE 3.8-INCH HOWITZER CARRIAGE, MODEL OF 1915.

WEIGHTS, DIMENSIONS, ETC.

Weight of carriage, complete.....	pounds..	1, 620
Weight of howitzer and carriage, complete.....	do....	2, 040
Weight at end of trail, carriage limbered, howitzer engaged in traveling lock.....	pounds..	125

Diameter of wheel.....	inches..	56
Width of track.....	do.....	60
Height of axis of howitzer above ground.....	do.....	34
Height of line of peep sight above ground.....	do.....	39.875
Distance between front and peep sights.....	do.....	16.5
Maximum angle of elevation.....	degrees..	40
Maximum angle of depression.....	do.....	5
Length of recoil of howitzer on carriage, zero elevation.....	inches..	40
Length of recoil of howitzer at 40° elevation.....	do.....	22
Amount of traverse of howitzer on carriage.....	millièmes..	107
Weight of howitzer carriage and limber, loaded and equipped.....	pounds..	3,970.4
Free height under limber and carriage.....	inches..	18
Turning angle.....	degrees..	68
Distance, center of limber axle to center of carriage axle when limbered (wheel base).....	inches..	148.5
Distance of center of gravity in front of face of breech, model of 1908 howitzer.....	inches..	18
Distance of center of gravity in front of face of breech, model of 1908 M1 howitzer.....	inches..	18.65
Distance the cylinder and spring stirrup project beyond the cradle with springs free (about).....	feet..	5

NOMENCLATURE OF PARTS OF CARRIAGE.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
1	Trail complete, consisting of—			
1	Axle.....	Riveted in upper end of trail.....		
1	Axle arm (right).....	Shrunk on right end of axle.....		
1	Axle arm (left).....	Shrunk on left end of axle.....		
2	Studs.....	Screwed and pinned on axle arms.....		
2	Axle-arm plugs.....	Forced into axle arms.....		
4	0.25 x 0.75 pins.....	Secure axle-arm plugs in place.....		
1	Axle reinforce plate (right).....	Riveted to outside of right trail flask.....		
1	Axle reinforce plate (left).....	Riveted to outside of left trail flask.....		
1	Bottom plate.....	Forms bottom of tool and sight boxes.....		
1	Brake segment.....	Riveted on front end of right flask.....		
1	Brake-shaft bearing (right).....	Riveted to front, outside of right flask.....		
1	Bearing bushing.....	Forced into brake-shaft bearing.....		
1	Bearing filler piece.....	Under flange of brake-shaft bearing.....		
1	Brake-shaft bearing (left).....	Riveted to front, outside of left flask.....		
1	Bearing bushing.....	Forced into brake-shaft bearing.....		
1	Bearing filler piece.....	Under flange of brake-shaft bearing.....		
2	Cover hinges (female).....	Riveted to top plate.....		
2	Cover hinges (male).....	Riveted to tool and sight box covers.....		
2	Pins.....	In cover hinges.....		
1	Cover latch.....	Secures tool and sight box covers.....		
1	Cover-latch eye.....	Riveted to top plate.....		
1	Cover-latch hinge.....	do.....	IV	3
1	Pin.....	In cover-latch hinge.....		
2	Cover pulls.....	Riveted to tool and sight box covers.....		
1	Flask (right).....	Forms right side of trail.....		
1	Flask (left).....	Forms left side of trail.....		
1	Float.....	Riveted to top of flask at spade end.....		
1	Front trail clip (right).....	Bolted to right flask through brake-shaft bearing.....		
1	Front trail clip (left).....	Bolted to left flask through brake-shaft bearing.....		
4	0.375 x 0.78 bolts.....	Bolt clips to flasks.....		
1	Front transom.....	At middle of trail.....		
1	Handspike fastening.....	In spring.....		
1	Handspike fastening spring.....	Riveted to sight-box cover.....		
1	Left seat.....	Riveted to left seat support.....		
1	Left seat support.....	Riveted to left flask.....		
1	Lunette.....	In lunette bracket.....		
1	Lunette bracket.....	Riveted to spade end of trail.....		
1	Lunette nut.....	On lunette.....		
1	Middle transom.....	Connects flasks between tool and sight boxes.....		

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Trail complete, consisting of—Contd.			
1	Name plate.....	On top plate below sight box.....	IV	3
1	Padlock with chain and bolt snap.....	Secures cover latch.....		
1	Padlock chain rivet.....	Attaches padlock chain to top plate.....		
1	Pintle.....	Riveted on pintle plate.....		
1	Pintle plate.....	Connects forward ends of flasks.....		
1	Pintle axle plate.....	Reinforces pintle plate.....		
1	Rear trail clip (right).....	Riveted on flasks, embrace rear guides of top carriage.		
1	Rear trail clip (left).....			
1	Rear transom.....	Riveted to flasks.....		
1	Reinforce plate (right).....	Stiffen flask between axle and front transom.		
1	Reinforce plate (left).....			
1	Reinforce plate.....	Inside left flask at traversing pivot bracket.		
1	Right seat.....	Riveted to right seat support.....		
1	Right seat support.....	Riveted to right flask.....		
1	Segment rack.....	Riveted to brake segment.....		
1	Sight-box cover.....	Hinged to top plate.....		
1	Sight packing, No. 1, covered.....	In sight box.....		
1	Sight packing, No. 2, covered.....	do.....		
1	Sight packing, No. 3, covered.....	do.....		
1	Sight packing, No. 4, covered.....	do.....		
1	Sight packing, No. 5, covered.....	do.....		
1	Sight packing, No. 6, covered.....	do.....		
1	Sight packing, No. 7, covered.....	do.....		
1	Sight packing, No. 8.....	do.....		
1	Spade.....	Riveted to rear ends of flasks.....		
1	Spade edge.....	Riveted to face of spade.....		
1	Sponge staff fastening.....	Riveted to top plate.....		
1	Sponge staff fastening filler.....	Between fastening and top plate.....		
1	Sponge staff support.....	Riveted to top plate.....		
1	Sponge staff fastening spring.....	In fastening lever.....		
1	Sponge staff fastening lever.....	Pinned to fastening support.....		
1	Tool-box cover.....	Hinged to top plate.....		
1	Top plate.....	Riveted to top of flasks.....		
1	Trail-bearing plate (right).....	On forward end of right flask.....		
1	Trail-bearing plate (left).....	On forward end of left flask.....		
1	Trail handle (right).....	Riveted to float.....		
1	Trail handle (left).....	do.....		
1	Traveling-lock bearing (right).....	Riveted to under surface of flasks near axle.		
1	Traveling-lock bearing (left).....			
1	Traveling-lock clip.....	Riveted to traveling-lock support.....		
1	Traveling-lock support.....	Between reinforce plates of flasks, near axle.		
1	Traversing-pivot bracket.....	Riveted to left flask.....		
2	Wheel guards.....	Riveted to flasks.....		
1	Handspike, complete, consisting of—			
2	Handspike bodies, with rivet and washers.....	Sides of handspike.....		
1	Handspike bolt, with nut.....	Bolts handspike web to lunette bracket.....		
1	Handspike rivet.....	Assembled in handspike web.....		
1	Handspike web.....	Center of handspike.....		
1	Handspike lower band.....	Ties handspike body to handspike web.....		
1	Handspike middle band.....	do.....		
1	Handspike tip.....	do.....		
1	Traveling lock, complete, consisting of—			
1	Traveling lock.....	Bolted to traveling-lock bearings.....		
2	Lock-bearing bolts with nuts.....	Secure traveling lock to bearings.....		
1	Locking pin with spring.....	Secures traveling lock in either front or rear position.		
1	Chain.....	Secures locking pin.....		
2	Chain rings.....	do.....		
1	Eyebolt.....	do.....		
1	Top carriage, complete, consisting of—			
2	Bracket studs.....	In trunnion cap (left).....		
1	Elevating-gear case (right).....	Bolted to top-carriage side frames.....		
1	Elevating-gear case (left).....			
8	0.375 fillister head screws.....	Attach the gear cases to side frames.....		
1	Liner (right).....	Wearing strip at front guide.....		
1	Liner (left).....	do.....		
10	0.112x0.125 St'd c' sunk head screws.....	Attach liners to front guides.....		
1	Pintle bushing.....	In pintle socket.....		
4	0.187 (1/8) x 0.375 pins.....	Hold bushing in place.....		
1	Pintle socket.....	Riveted to bottom plate.....		
1	Top-carriage bottom plate.....	Riveted to side frames.....		
1	Top-carriage side frame (right).....	Forms support for howitzer.....		
2	0.312 (5/16) x 0.562 (9/16) dowel pins.....	On right side frame.....		
1	Top-carriage side frame (left).....	Forms support for howitzer.....		
4	Bushings.....	Half bushings pinned in seats for worms.....		
1	Trunnion cap (right).....	Over trunnion bushings.....		

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Top carriage, complete, consisting of—Continued.			
1	Trunnion cap (left).....	Over trunnion bushings.....		
4	Trunnion-cap pins.....	Hinge trunnion caps and swing bolts to side frames.		
2	Trunnion-cap swing bolts.....	Secure trunnion caps.....		
1	Worm-bearing cap (right).....	Bolted to worm bearing of side frames.....		
1	Worm-bearing cap (left).....	do.....		
4	Bushings.....	Half bushings in worm-bearing caps.....		
4	0.187 ($\frac{3}{16}$) pins.....	Hold bushings in place.....		
8	0.375 x 2.125 fillister-head screws.....	Bolt worm-bearing caps to worm bearings.		
1	Elevating mechanism, complete, consisting of—			
2	Elevating gears.....	On ends of elevating shaft.....		
1	Elevating-gear cover (right).....	Bolted to elevating-gear cases.....		
1	Elevating-gear cover (left).....	do.....		
8	0.375 fillister head screws.....	Attach gear covers to gear cases.....		
1	Elevating pinion (right).....	Mesh with bevel gears of worms.....		
1	Elevating pinion (left).....	do.....		
1	Elevating shaft.....	In bearings in the elevating gear cases.....		
3	Washers.....	On shaft.....		
2	Handwheels, elevating, complete, consisting of—			
2	Counterbalance.....	On ends of handwheel shafts.....		
2	Handwheel body.....	do.....		
2	Hub.....	do.....		
2	Reinforce piece.....	do.....		
2	Sleeve.....	do.....		
2	Spindle.....	do.....		
2	0.1 x 0.437 ($\frac{1}{8}$) pins.....	do.....		
1	Handwheel shaft (right).....	In handwheel shaft bearing.....		
1	Handwheel shaft (left).....	In handwheel shaft bracket.....		
1	Handwheel shaft bearing.....	Po'ted to top carriage side frame, right.....		
6	0.25 x 1.062 ($1\frac{1}{8}$) bolts.....	Attach bearing to side frame and bearing caps.		
2	0.312 ($\frac{5}{16}$) x 1.125 standard fillister screws.....	do.....		
2	0.312 ($\frac{5}{16}$) x 1 standard fillister screws.....	do.....		
1	Handwheel shaft bearing cap.....	On handwheel shaft bearing.....		
1	Handwheel shaft bracket.....	Po'ted to top carriage side frame, left.....		
1	0.375 x 1.187 ($1\frac{1}{8}$) bolt.....	Polts shaft bracket to top carriage.....		
1	Handwheel shaft bracket bolt.....	The lower bolt attaching the bracket.....		
1	Intermediate elevating pinion.....	On rear end of intermediate elevating shaft.....		
1	0.162 ($\frac{1}{4}$) x 1.75 taper pin.....	Pins elevating pinion to shaft.....		
1	Intermediate elevating shaft.....	Along right side of top carriage.....		
1	Rocker, right.....	On trunnion bushings, between cradle and top carriage.		
1	Rocker, left.....	do.....		
2	Rocker washers.....	Pinned and finished on rockers.....		
1	Rocker brace.....	Ends bolted to rockers.....		
8	0.375 x 1.125 standard fillister screws.....	Attach rockers to rocker brace.....		
2	Trunnion bushing.....	On cradle trunnions.....		
2	Worms (Hindle).....	Assembled in bearings, engage rockers.....		
1	Traversing mechanism, complete, consisting of—			
1	Handwheel, traversing, consisting of—			
1	Counterbalance.....	On traversing screw.....		
1	Crank pin.....	do.....		
1	Crank plate.....	do.....		
1	Crank sleeve.....	do.....		
1	Hub.....	do.....		
1	Washer.....	do.....		
1	Wheel body.....	do.....		
2	Traversing bearing caps.....	Screwed to top carriage side frame, left.....		
4	Traversing bearing cap screw.....	Secure caps to top carriage.....		
1	Traversing nut.....	Trunnioned in top carriage side frame, left.....		
1	Traversing pivot.....	In traversing pivot bracket.....		
1	Traversing screw, with 2 nuts.....	Assembled in traversing pivot and traversing nut.		
1	Cradle, complete, consisting of—			
5	Bracket pins.....	Hinge swing bolts in cradle brackets.....		
2	Bracket studs.....	At rear end of cradle secure firing handle bracket.		
5	Clip pins.....	Hinge swing bolts in cradle bracket.....		
1	Cradle bottom plate.....	Attached to bottom of cradle plate.....		
1	Cradle head, rear.....	In rear end of cradle.....		
1	Bushing.....	Riveted in with cradle head, rear.....		
1	Cradle plate.....	Riveted to cradle bottom plate.....		

IV

3

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Cradle complete, consisting of—Contd.			
6	Spring covers, No. 2.....	Close oil holes.....		
1	Spring cover, No. 3.....	Closes hole over filling plug of cylinder.....		
2	Cradle head side clip.....	Riveted on front end of cradle plate.....		
1	Cradle head top clip.....	.....do.....		
1	Cradle head, front.....	Polted to front end of cradle.....		
1	Bushing.....	Forced into cradle head, front.....		
1	Gun slide (right).....	Bearings on which the howitzer slides.....		
1	Gun slide (left).....	.....do.....		
1	Handle racket.....	Riveted on right rear end of cradle.....		
1	Patent plate.....	On right side of cradle plate.....		
2	Screws.....	Attach patent plate to cradle plate.....		
1	Plunger guide (right).....	Riveted to rear end of cradle.....		
1	Plunger guide (left).....	.....do.....		
1	Shoulder guard.....	Riveted on rear end of cradle plate.....		
1	Spring retainer bracket (right).....	Riveted on front end of cradle plate.....		
1	Spring retainer bracket (left).....	.....do.....		
1	Spring retainer.....	In front end of cradle.....		
5	Swing bolts.....	Assembled to bracket on front of cradle.....		
1	Trunnion band.....	At middle of cradle.....		
4	0.190 x 0.75 c/sunk standard screw.....	Connect, trunnion band, bottom plate and liner.....		
1	Firing mechanism complete, consisting of—			
1	Adjusting screw.....	In firing handle bracket.....		
1	Firing handle.....	Attached to firing handle hub.....		
1	0.246 x 1.6 pin, type A.....	Attaches firing handle to hub.....		
1	Firing handle plunger.....	In firing handle.....		
1	Firing handle spring.....	.....do.....		
1	Firing handle bracket.....	Bolted to right side of cradle head rear.....		
1	Steel pin.....	In firing handle bracket.....		
1	Firing handle hub.....	Assembled on firing shaft.....		
2	Firing links.....	Connect firing shaft and firing pallet.....		
2	Firing link pins.....	Secure links.....		
1	Firing pallet.....	In lower bearing of firing handle bracket.....		
1	Firing pallet collar.....	On front end of firing pallet.....		
1	Firing shaft.....	In upper bearing of firing handle bracket.....		
1	Handle return spring.....	The front spring in the firing handle bracket.....		
1	Pallet collar pin.....	Secures firing pallet collar.....		
1	Shaft return spring.....	The rear spring in the firing handle bracket.....		
1	Shaft trip collar.....	On front end of firing shaft.....		
1	Trip collar pin.....	Secures shaft trip collar.....		
1	Trip latch.....	Assembled in firing handle hub.....		
1	Trip latch pin.....	.....do.....		
1	Trip latch plunger.....	.....do.....		
1	Trip latch spring.....	.....do.....		
2	Inner counter recoil springs.....	Assembled inside stirrups.....		
2	Outer counter recoil springs.....	Assembled in cradle.....		
1	Recoil cylinder complete, consisting of—			
1	Counter recoil buffer.....	Screwed into rear cylinder head.....		
1	Cylinder liner.....	Assembled in cylinder.....		
1	Cylinder liner lock.....	Prevents turning of liner in cylinder.....		
1	Cylinder liner lock gasket.....	On liner lock.....		
1	Cylinder locking screw.....	Locks cylinder retaining ring on cylinder.....		
1	Cylinder retaining ring.....	On cylinder in rear of gun lug.....		
2	Screw plugs.....	Fill threaded holes in cylinder retaining ring.....		
1	Filling plug.....	In front end of cylinder.....		
1	Filling plug gasket.....	On filling plug.....		
2	Filling and drain plugs.....	In front cylinder head.....		
1	Front cylinder head.....	Screwed into cylinder.....		
1	Fiber gasket.....	In front cylinder head.....		
2	Copper gaskets.....	.....do.....		
4	Rings, waterproof packing, garlock.....	.....do.....		
1	Gland lock.....	Prevents turning of piston-rod gland.....		
1	Piston and piston rod.....	In recoil valve.....		
1	Piston liner.....	Finished in place on piston.....		
3	Screws.....	Hold liner in place on piston.....		
1	Piston rod gland.....	Screwed in front cylinder head.....		
1	Piston rod nut.....	On front end of piston rod.....		
1	Piston rod washer.....	Between piston rod nut and cradle head front.....		
1	Rear cylinder head.....	Screwed into cylinder.....		
1	Fiber gasket.....	On rear cylinder head.....		
1	Copper gasket.....	.....do.....		

IV

3

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Recoil cylinder complete, consisting of—Continued.			
1	Recoil cylinder.....	Rear end attached to gun lug of howitzer..		
1	Recoil valve.....	Rotates in cylinder liner.....		
1	Spring follower.....	Assembled on front end recoil cylinder.....		
1	Spring separator, inner.....	Between two inner counter recoil springs..		
1	Spring separator, outer.....	Between two outer counter recoil springs..		
1	Spring stirrup, complete, including—			
1	Spring stirrup.....	Assembled inside of outer counter recoil springs.		
1	Spring stirrup inner ring.....	In rear end of spring stirrup.....		
2	0.190 x 0.875 standard filister screws.	Hold ring in place.....		
1	Spring stirrup outer ring.....	On front end of spring stirrup.....		
2	0.190 x 1.25 standard filister screws.	Hold ring in place.....		
1	Valve retainer.....	In front end of cylinder liner.....		
1	0.190 x 0.375 standard filister screw.	Holds retainer in position.....		
1	Vent gasket.....	Assembled in rear end of recoil cylinder under gun lug plug.		
1	Vent plug.....			
1	Valve turning gear, complete, consisting of—			
1	Collar.....	On valve turning gear.....		
1	0.135 x 1.562 ($\frac{1}{8}$) taper pin.....	Holds collar in position.....		
1	Connecting rod.....	In lower right corner of cradle, forward of trunnion.		
1	Connecting rod nut.....	On rear end of connecting rod.....		
1	Connecting rod pin (front).....	Attaches connecting rod to valve turning gear.		
1	Connecting rod pin (rear).....	Attaches connecting rod to right trunnion cap of top carriage.		
1	Slide.....	On rear end of connecting rod.....		
1	Valve turning gear.....	Assembled in right side of cradle head front.		
1	Valve turning pinion.....	On piston rod in bore of cradle head front..		
1	Quick return mechanism, complete, consisting of—			
1	Latch.....	On right end of pawl shaft.....		
1	Link.....	Connects pawl handle and latch.....		
1	0.318 x 1.45 pin.....			
2	Link pin washers.....	On link pin.....	IV	3
1	Pawl, right.....	On boss of cradle head rear.....		
1	Pawl, left.....	do.....		
2	Bushings.....	In pawls.....		
4	0.125 x 0.281 ($\frac{1}{8}$) pins.....	Hold bushings in position.....		
1	Pawl handle.....	Pivoted to cradle bracket of cradle.....		
1	0.492 x 1.8 pin.....			
1	0.368 x 1.3 pin.....			
1	Pawl shaft.....	Connects right and left pawls.....		
2	Pawl springs.....	Assembled on plunger rods.....		
2	Plunger rods.....	In plunger guides on cradle.....		
2	Plunger rod pins.....	Connect plunger rods and pawls.....		
2	Axle seats, complete, consisting of—			
1	Bracket support, inner (right).....	Clamps on axle.....		
1	Bracket support, inner (left).....	do.....		
8	Bracket support inner bolts.....	In bracket supports.....		
1	Bracket support, outer (right).....	Clamps on axle.....		
1	Bracket support, outer (left).....	do.....		
2	0.875 x 4.96 bolts.....	In bracket supports, outer.....		
2	Brake beam fulcrums.....	Riveted to outer seat brackets.....		
2	Brake beam guides.....	Riveted to inner seat brackets.....		
2	Foot rests.....	Riveted to front ends of seat brackets.....		
2	Foot-rest braces.....	do.....		
1	Latch base, right.....	Riveted to inner seat bracket.....		
1	Latch base, left.....	do.....		
1	Left bracket support cap.....	Bolted to left bracket support, inner.....		
4	Lower shield fastenings.....	Riveted to seat brackets.....		
4	0.375 x 0.78 bolts.....	Hold lower shield fastening to shield.....		
1	Right bracket support cap.....	Bolted to right bracket support, inner.....		
1	Seat, right.....	On seat support.....		
1	Seat, left.....	do.....		
1	Seat arm (right).....	Riveted to seat arm bracket.....		
1	Seat arm (left).....	do.....		
1	Seat arm bracket (right).....	Connection between seat support, seat arm and shield brace.		
1	Seat arm bracket (left).....	do.....		
1	Seat arm guard (right).....	Riveted to seat arm and upper shield brace.		
1	Seat arm guard (left).....	do.....		
1	Seat bracket (inner, right).....	Riveted to bracket supports.....		

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Axle seats, complete, consisting of—			
	Continued.			
1	Seat bracket (inner, left).....	Riveted to bracket supports.....		
1	Seat bracket (outer, right).....	do.....		
1	Seat bracket (outer, left).....	do.....		
2	Seat bracket ties.....	Riveted to inner and outer seat brackets..		
2	Seat support foot (right).....	Riveted to seat brackets.....		
2	Seat support foot (left).....	do.....		
1	Seat support, inside (right).....	Form braces under seat.....		
1	Seat support, inside (left).....	do.....		
2	Seat supports, outside.....	do.....		
1	Segment rack.....	Riveted to right bracket support cap.....		
2	Shield braces, upper.....	Support shield.....		
2	Shield braces, lower.....	do.....		
1	Shield brace bracket (right).....	At upper ends of seat arms and shield braces.		
	do.....	do.....		
1	Shield brace bracket (left).....	do.....		
1	Shield brace foot (right).....	Riveted to seat brackets.....		
	do.....	do.....		
1	Shield brace foot (left).....	do.....		
1	Road brake, complete, consisting of—			
1	Brake beam (right).....	Pivoted in seat brackets.....		
1	Brake beam (left).....	do.....		
1	Brake crank.....	Pinned on left end of brake shaft.....		
1	Brake lever.....	Pinned on right end of brake shaft.....		
1	Brake lever hook.....	Assembled on brake lever.....		
2	Brake lever catches.....	do.....		
1	Brake lever pin.....	do.....		
2	Brake rods, complete, consisting of—	Connect brake beams to brake cranks.....		
	of—			
2	Brake rods.....	do.....		
2	Brake-rod ends.....	On forward ends of brake rods.....		
2	Brake-rod springs.....	Assembled on brake rods.....		
2	Brake-spring covers.....	Housing for brake rod springs.....		
2	Brake spring cover heads.....	Screws into brake spring cover.....		
2	Brake-spring cover ends.....	do.....		
3	Brake-rod pins.....	Connect brake rod ends to brake beams and brake crank to left brake spring cover end.		
1	Brake shaft.....	Assembled in bearings in trail.....		
2	Brake shoes.....	On brake beams.....		
4	Brake shoe tap bolt.....	Bolt brake shoes to brake beams.....		
2	Fulcrum pin.....	Through brake beams and brake beam fulcrums.....		
2	Apron latches, complete, consisting of—			
	Handle pins.....	do.....		
2	Latch bodies.....	Mounted on latch bases.....		
2	Latch handles.....	Mounted on latch bodies.....		
2	0.368 x 1.55 pins.....	Assembled with latch body.....		
2	Latch springs.....	In latch bodies.....		
2	Plungers.....	Assembled in latch bodies.....		
1	Shield, complete, consisting of—			
	Apron, complete, consisting of—			
1	Apron.....	Hinged to seat bracket supports.....		
4	Apron hinges.....	Riveted to apron.....		
4	Apron hinge pins.....	Assembled with apron hinges.....		
2	Apron latch staples.....	Riveted to apron.....		
1	Main shield, complete, consisting of—			
1	Diagonal shield brace (right).....	Braces shield from axle.....		
1	Diagonal shield brace (left).....	do.....		
2	0.625 x 1.343 (1½) bolts.....	Attach main shield to braces.....		
4	Diagonal shield brace bracket.....	Clamp axle.....		
2	0.75 x 5.062 (5¼) bolts.....	Through brackets.....		
2	0.75 x 4.562 (4¼) bolts.....	do.....		
1	Main shield, upper half.....	Bolted to bracket supports.....		
1	Main shield, lower half.....	do.....		
1	Panoramic sight case, complete, with padlock and chain.....	Suspended by spring in bracket.....		
1	Panoramic sight case bracket.....	Bolted to main shield.....		
1	Springs.....	Assembled between bracket and case.....		
1	Spring support (right).....	Riveted to bracket.....		
1	Spring support (left).....	do.....		
4	0.375 pipes.....	On bolts.....		
4	Bolts.....	Secure case to bracket.....		
1	Range quadrant case, complete, with padlock and chain.....	Suspended by springs in bracket.....		
1	Range quadrant case bracket.....	Bolted to main shield.....		
8	Springs.....	Assembled between bracket and case.....		
1	Spring support (right).....	Riveted to bracket.....		
1	Spring support (left).....	do.....		

IV

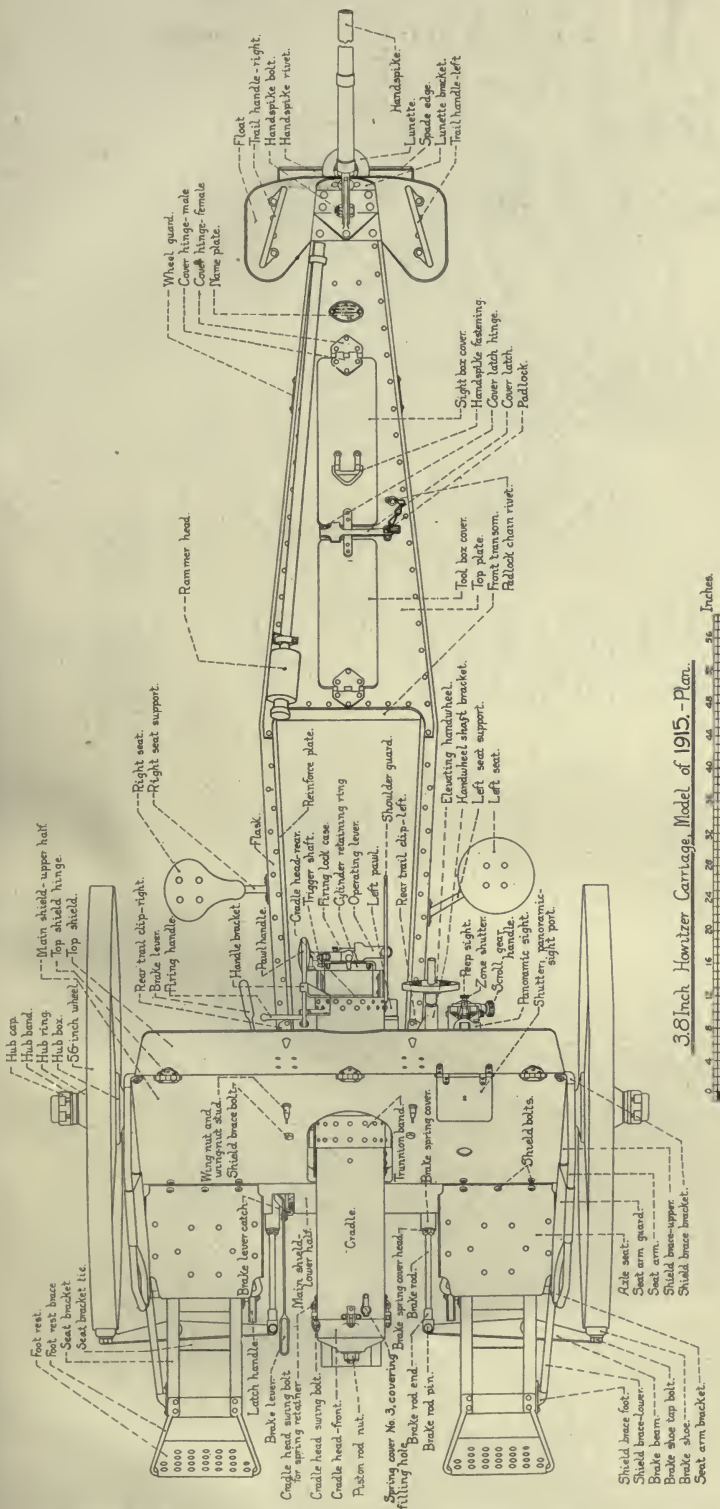
3

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

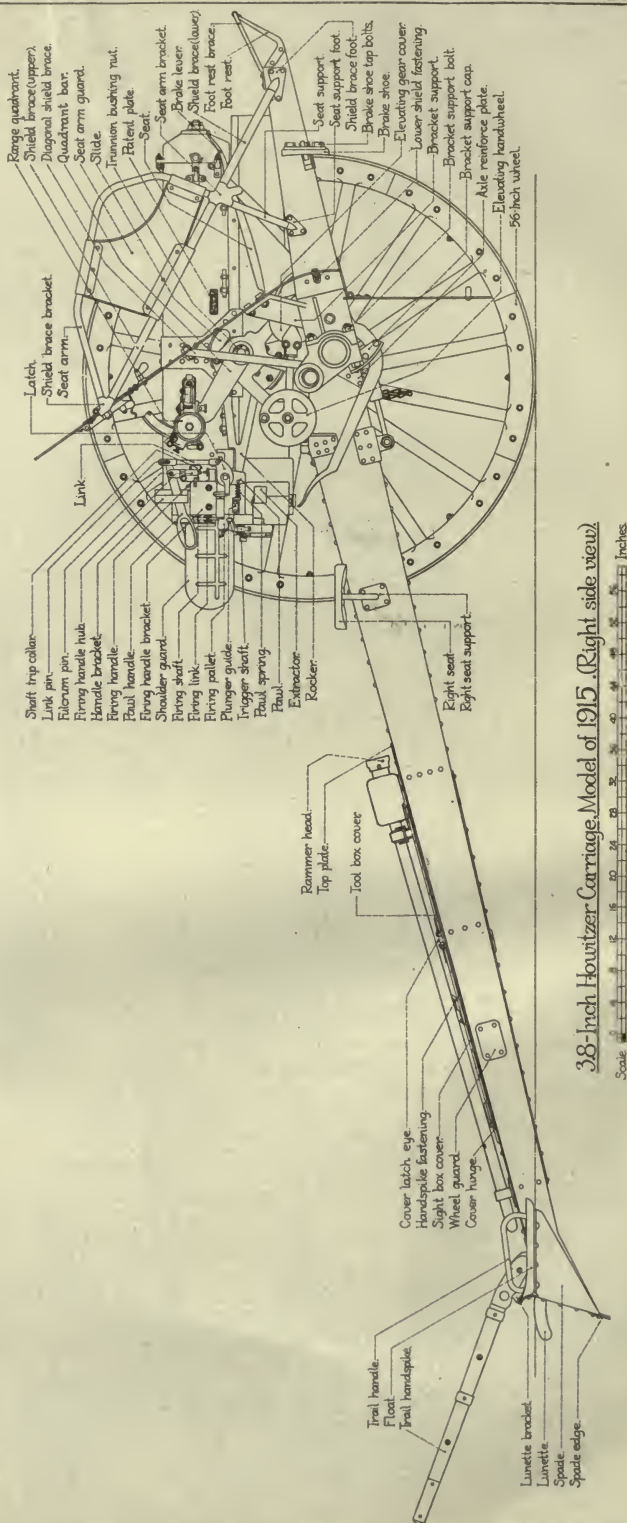
No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Main shield, complete, consisting of—			
	Continued.			
4	0.375 pipes.....	On bolts.....		
4	Bolts.....	Secure case to bracket.....		
1	Safety depression stop (right).....	Riveted to upper main shield.....		
1	Safety depression stop (left).....	do.....		
12	Shield bolts.....	Secure main shield.....		
3	Shield hinge pins.....	In top shield hinges.....		
3	Top shield hinges, lower half.....			
2	Wing nut pins (front).....	Riveted to main shield.....		
2	Wing nut pins (rear).....			
4	Wing nuts.....	On wing nut studs.....		
1	Top shield, complete, consisting of—			
4	Fastening hinges.....	Riveted to top shield.....		
2	Fastening hinge pins.....	Assembled with fastening hinges.....		
2	Fillers, shutter hinge.....	Under sight-port shutter hinges on shield.....		
4	Hinges, sight-port shutter.....	Riveted to top shield and sight-port shutter.....		
1	Hinge pin, sight-port shutter.....	Assembled in hinges.....		
1	Shutter, panoramic sight port.....	Covers sight port.....		
1	Shutter support.....	Riveted to shutter.....		
1	Top shield.....	Pinned to main shield.....		
2	Top shield fastenings.....	Pinned to fastening hinges.....		
3	Top shield hinges, upper half.....	Riveted to top shield.....		
1	Front sight, complete.....	Bolted to left trunnion cap.....		
1	Sight bar with shank socket.....	Keyed to left trunnion bushing.....		
1	Sight shank.....	In sight packing intrail.....		
1	Range quadrant.....	In case.....		
1	Range quadrant bar.....	Keyed to right trunnion bushing.....		
1	Panoramic sight.....	In case.....		
1	Teat wrench for panoramic sight.....	do.....		
2	Wheels, 56-inch, complete, consisting of—			
16	Tire bolts, with nuts and washers.....			
16	Dowels.....			
64	Felloe rivets and washers.....			
16	Felloe segments.....			
32	Spokes.....			
2	Tires.....			
2	Hub boxes.....			
2	Hub liners.....	Forced into hub boxes.....		
2	Hub rings.....	Outer flanges of hubs.....		
16	Carriage bolts.....			
16	Carriage bolt nuts.....			
2	Hub bands.....	Screwed into hub boxes.....		
2	Lock washers.....	Between hub bands and hub rings.....		
2	Hub caps.....	On end of hubs.....		
2	Hub latches with rivets.....	Actuate hub-latch plungers.....		
2	Hub-latch springs.....			
2	Hub-latch plungers.....	Lock hub caps in place.....		
2	Oil valves.....	Slide in hub caps.....		
2	Washers (oil valve).....			
2	Springs (oil valve).....			
2	Wheel fastenings.....	On ends of axle.....		
	Consisting of—			
2	Wheel fastening plungers.....			
2	Wheel fastening springs.....			
2	Plugs.....			
	<i>Handy oilers.</i>			
6	0.312($\frac{1}{8}$) inch.....			
28	0.375-inch.....			
	<i>Crown nuts—Standard.</i>			
6	0.25-inch.....			
4	0.312($\frac{1}{8}$) inch.....			
48	0.375-inch.....			
8	0.5-inch.....			
17	0.625-inch.....			
17	0.75-inch.....			
	<i>Crown nuts—Special.</i>			
3	0.75 blank, 0.875 tap, st'd.....			
2	1 x 0.937 ($\frac{1}{8}$) inch.....			

IV

3



3.8 inch Howitzer Carriage, Model of 1915.-Plan.



38-Inch Hovitzzer Carriage, Model of 1915. (Right side view).



3.8-Inch Howitzer Carriage, Model of 1915.-Left Side View.

NOMENCLATURE OF PARTS OF CARRIAGE—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
Split pins.				
1	0.046 (M) x 0.312 (H) inch.....		IV	3
1	0.062 (M) x 0.375 inch.....			
2	0.062 (M) x 0.562 (H) inch.....			
4	0.062 (M) x 1 inch.....			
2	0.093 (H) x 0.5 inch.....			
1	0.093 (H) x 1 inch.....			
7	0.125 inch x 0.75 inch.....			
4	0.125 inch x 1 inch.....			
2	0.125 x 1.25 inch.....			
1	0.125 x 1.5 inch.....			
2	0.125 x 1.75 inch.....			
1	0.156 (H) x 0.5 inch.....			
4	0.156 (H) x 1 inch.....			
3	0.156 (M) x 2 inch.....			
2	0.203 (M) x 1.5 inch.....			
1	0.203 (H) x 2 inch.....			

DESCRIPTION OF THE CARRIAGE.

[Plates VI, VII, VIII, IX.]

The 3.8-inch howitzer carriage, model of 1915, is of the type known as the variable recoil, in which the howitzer is permitted a sufficient length of recoil on the carriage at low angles of elevation to insure stability of the carriage under firing stresses, and in which the length of recoil is reduced at high angles of elevation to maintain clearance from the ground.

For the purpose of description, the carriage is considered as composed of the following groups, cradle (complete), top carriage, elevating mechanism, quick-return mechanism, trail (including axle), traversing mechanism, axle seats, road brake, shield, traveling lock, and wheels.

A detailed description of each of the above groups follows:

CRADLE COMPLETE.

Under this group are considered the cradle, the recoil-controlling parts, the valve-turning mechanism, and the firing mechanism.

The cradle supports the howitzer, guides it in recoil, and forms a housing for the recoil mechanism and parts of the valve-turning mechanism. It consists of the cradle bottom plate, gun slides, cradle plate, cradle head (rear), trunnion band, shoulder guard, and several other attachments riveted thereto.

The cradle bottom plate is made of forged steel. It is shaped on the underside so as to form two clips. These clips are lined with bronze gun slides and form ways in which the howitzer recoils.

A rib on the top of the cradle bottom plate forms a bearing and support for the stirrup outer ring, and acts also as a guide for the spring stirrup during the recoil.

The cradle plate is arch shaped and made of flange steel, the sides being riveted to the flanges on the bottom cradle plate. The cradle head, rear, is made of cast steel, bushed with a bronze bushing. It is riveted to the rear end of the cradle plate and to the cradle bottom plate and is used to take the thrust of the outer spring column and support the rear end of the spring stirrup.

The trunnion band is of forged steel riveted about the cradle plate and locates the trunnions so as to bring the preponderance of the loaded howitzer at the breech and of the unloaded piece at the muzzle, thus aiding the movements to and from the loading position. The trunnions, integral with the band, are bored out in the center to reduce the weight. The band above the right trunnion has a slot cut in its center for a boss on the connecting rod of the valve turning gear. This slot is covered by a bronze slide.

Bosses on either side of the cradle head, rear, form bearings for the pawls of the quick return mechanism. The pawls are assembled to the pawl shaft, which extends through these bearings and the cradle. In front of the pawl bearings projections on the cradle head, rear, are machined into bearings for the rocker. Above the pawl bearings on the right side of the cradle is riveted the handle bracket of the quick return mechanism.

The shoulder guard is of flange steel and is riveted to the left side of the cradle. Brackets for securing the cradle head, front, and spring retainer to the cradle are riveted to the front end of the cradle plate.

The recoil-controlling parts of the carriage include the counter-recoil springs, spring stirrup, recoil cylinder, cylinder liner, recoil valve, piston, counter-recoil buffer, and cradle head, front.

Immediately inside the cradle plate are located the two helical spring sections comprising the outer counter recoil spring column. The sections are separated by the outer spring separator. The rear end of the column bears against the bushing of the cradle head, rear, and the front end against the stirrup outer ring. The stirrup outer ring is screwed and pinned at the front end of the spring stirrup.

The spring stirrup is a forged-steel tube which separates the outer and inner spring columns. Inside the rear end of the spring stirrup is threaded and pinned the bronze stirrup inner ring, which is bored out so as to form a sliding fit for the recoil cylinder. Immediately inside the spring stirrup are located the two helical spring sections, comprising the inner counter recoil spring column. These sections are similarly separated by the inner spring separator. The rear end of the column bears against the stirrup inner ring, while the front end bears against the spring follower.

The spring follower is a bronze ring which fits over the recoil cylinder immediately in rear of the shoulder on the front end of the cylinder.

der. In carriages Nos. 1 to 8, inclusive, the shoulder on the cylinder is replaced by a spring compressing ring threaded on and locked in place.

The forged steel spring retainer is secured to the cradle by means of two lugs and swing bolts. It is located just in front of the spring stirrup and spring follower and serves to hold the springs in position when the cylinder is removed, or the cylinder retaining ring unscrewed.

The springs are assembled in the carriage under sufficient tension to return the howitzer into battery at maximum angles of elevation. The approximate force exerted by the springs at assembled heights is 750 pounds.

The recoil cylinder extends to the rear through the stirrup inner ring and the lug of the howitzer and is locked to the lug by the cylinder retaining ring screwed on its rear end.

The front cylinder head closes the forward end of the cylinder. The stuffing box is packed with four rings of Garlock hydraulic water-proof packing, held by the bronze piston rod gland, threaded to the cylinder head. Two holes through the walls of the cylinder head are closed by filling and drain plugs and copper gaskets.

A filling plug is located near the top of the cylinder in its assembled position in the cradle and immediately in rear of the front cylinder head. Access to it is gained through a hole with a spring cover located on the cradle plate. The vent plug is located on the top of the cylinder near its rear end. Access to it is gained through the hole for the gun lug plug of the howitzer. The rear cylinder head closes the rear end of the recoil cylinder. It is threaded to the cylinder and in turn is bored and threaded for the counter-recoil buffer. Both the front and rear cylinder heads are supplied with fiber gaskets to insure oil-tight joints.

The cylinder liner is a tube assembled inside the cylinder, the front end being threaded inside and out for a short distance and the rear end fitting into a tapered seat of the cylinder. The cylinder liner lock threaded in the cylinder and extending through it into the liner prevents any turning of the liner in the cylinder and similarly a pin in the howitzer lug prevents rotation of the cylinder in the lug.

The outer threads at the front end of the liner secure the liner in the cylinder; the inner threads are for the valve retainer which limits the longitudinal motion of the valve in the liner. The retainer is secured in its proper position in the liner by a small filister head steel screw.

Between the end bearings of the liner, the cylinder is counter-bored to a larger internal diameter. The space thus created is called the by-pass. It is utilized for the passage of oil from the front to the rear of the piston head.

Parallel to the axis of the liner are cut three rows of ports through its wall. These rows are 120° apart and are for the purpose of connecting the valve chamber with the by-pass. At the extreme rear end of the liner are drilled additional holes for the same purpose.

Fitting with a very small clearance inside of the cylinder liner, but free to rotate in it, is the recoil valve. This valve is a hollow cylinder having three equally spaced longitudinal ribs or keys on its inner surface. Rows of round holes parallel to each other and to the axis of the valve are drilled through the wall. The number of holes in any one row is practically the same as the number in each of the rows 120° from it. The total number of holes in three rows 120° apart varies from that in any other three rows 120° apart, except where the length of recoil is the same, and depends on the number of apertures needed at any given length of recoil for the passage of the oil from the interior of the valve through the liner ports into the by-pass and back to the other side of the piston head.

The bronze piston liner working inside the valve and bolted to the head of the piston rod has three notches or keyways which fit over the ribs or keys of the recoil valve. This piston liner fits closely inside of the valve and practically prevents any oil from passing from one side of the piston head to the other except through the holes in the valve and liner, and the by-pass. The piston and piston rod extends through the stuffing box in the front cylinder head and through the valve-turning pinion, as hereafter described. The rear end of the piston and piston rod is bored out to receive the counter-recoil buffer which fits into this bore with a very small clearance.

The buffer is threaded in the rear cylinder head and moves with it during recoil. In counterrecoil the oil caught in the piston and piston-rod bore can escape only by the small clearance around the buffer. This checks the return into battery so that very little shock and derangement of aim is experienced.

The front end of the cradle is closed by the cradle head, front, a forged steel piece with three projecting lugs. It is secured to the cradle plate by three brackets and swing bolts. The cradle head is bored out and is used to cover parts of the valve-turning mechanism.

The valve-turning mechanism consists of the valve-turning pinion, the valve-turning gear, the connecting rod, the connecting-rod pins, and several other small parts. The hub of the valve-turning pinion fits into the bearing formed by the bore in the cradle head, front. A shoulder on the piston rod and the piston-rod nut prevent longitudinal movement. The front end of the piston rod passes through the valve-turning pinion. The rod is so shaped as to prevent assembling the pinion and bronze piston-rod washer on it in but one position. The piston-rod washer is located just in rear of the piston-rod nut. The piston rod and valve-turning pinion are free to revolve in the

cradle head, but the longitudinal movement is prevented as indicated above.

A zero mark on the piston-rod washer, together with a scale on the hub of the cradle head, front, serve to indicate the approximate elevation of the howitzer for which the valve is set. Should the reading of the valve differ by more than 3° from the actual elevation as determined by separate measurement, the assembling of these parts should be checked. A slight variation is to be expected, due to necessary tolerances and wear.

The valve-turning pinion meshes with the valve-turning gear. This gear has a horizontal arm which is journaled in a boss on the right side of the cradle head, front. The valve-turning gear has a vertical arm with an offset, which is pinned by the connecting-rod pin, front, to the front end of the connecting rod, the latter being located in the lower right corner formed by the cradle plate and the cradle bottom plate.

The rod has a boss on its rear end which projects through the right side of the cradle, the trunnion band, and the slide. The boss is connected by means of the connecting-rod pin, rear, to the trunnion cap, right. A connecting-rod nut screws down on the boss and prevents transverse motion of the boss, but allows longitudinal motion of the boss and slide in the slot of the cradle.

Action of mechanism during recoil.

Turning the elevating handwheel causes displacement of the cradle with reference to the rear end of the connecting rod, as the latter is pinned to the trunnion cap, right. The longitudinal displacement is transmitted at the forward end of the connecting rod to the vertical arm of the valve-turning gear, causing the gear to rotate, and also the valve-turning pinion. The piston rod and valve also rotate with the pinion. The amount the valve is rotated in the liner, therefore, depends directly on the amount the elevating handwheel is turned, by which means the throttling orifice is regulated, as explained further below, by the elevation of the piece.

Thus the gears and other parts of the valve-turning mechanism are so assembled that as the howitzer is elevated the piston and piston rod, and with it the valve, are rotated inside the cylinder liner through a proportionate angle; 45° movement of the howitzer corresponds to 100° movement of the valve. As stated before, there are three rows of ports in the cylinder liner 120° apart. Similarly, there are three sets of rows of holes in the valve, the corresponding rows of each of the three sets having practically the same number of holes, while for all adjacent rows, except such as have identical lengths of recoil, the number varies.

For the howitzer at 5° depression, the three rows having the largest number of holes are opposite the ports of the liner, while for higher elevation the valve turns, putting rows with a less number of holes opposite the ports. In this way the orifice through which the oil passes from one side of the piston head to the other is automatically reduced as the howitzer is elevated.

When the howitzer recoils it pulls with it the cylinder, the cylinder liner, the valve, and, by the medium of the springs, the spring stirrup. The piston being fastened to the cradle head, front, remains stationary. The oil in front of the piston head is forced through such holes in the valve as may be opposite the liner ports and through the ports into the by-pass. From there it is forced again through the ports and holes in the valve into the valve chamber in rear of the piston head.

The energy of recoil of the piece is absorbed by the resistance which the oil offers to being forced through the small openings and by the resistance of the counter-recoil springs. The energy stored in the springs returns the piece to battery. This return movement is checked by the counter-recoil buffer and limited by the gun lug coming in contact with the rear of the cradle.

The number of holes in the valve is calculated so as to stop the howitzer at a recoil of 40 inches at 5° depression and at a recoil of 22 inches at 40° elevation.

The carriage mechanism for firing the howitzer is as follows: A firing pallet has its bearing arm assembled in the lower projection of the firing handle bracket, riveted to the rear end of the cradle on the right side. The pallet or lip is in such a position as to engage an arm on the trigger shaft of the breech mechanism. A helical spring in the upper projection of this bracket above and parallel to the firing pallet tends to hold the pallet in a position free from the trigger. In this upper part the firing shaft is assembled, having on its rear end a crank arm which is connected to a similar arm of the firing pallet by two links. The rotary movement of the pallet in its bearing, caused by its return spring, is limited by a stop pin in the bracket coming in contact with a projection on the firing shaft. On the forward end of the firing pallet is pinned the firing-pallet collar slotted to engage or lock with the latch of the quick-return mechanism when the latter is operated, so that the firing pallet can not be turned with the cradle free from the rockers. The forward end of the firing shaft is squared and fitted with a small shaft trip collar. The firing handle hub adjacent to the shaft trip collar and free to turn on the shaft carries a spring pawl trip latch which engages a notch of the trip collar. A helical spring in the upper part of the bracket rotates the firing handle hub into firing position. In another bearing, in the bracket, is located an adjusting

screw which limits the movement of the firing handle. The firing handle is so attached to the hub as to be folded down upon the bracket when not in use, in which position it is kept from turning by a projection fitting into a notch of the bracket. The firing handle spring within the handle forces the firing handle plunger against a shoulder on the bracket, thereby tending to hold the handle in its folded and open positions.

The action of the firing mechanism is as follows: Pulling the handle rotates the trip latch, shaft trip collar, firing shaft, and pallet until the head of the trip latch plunger on the end of which is located the trip latch strikes the adjusting screw in the bracket when the trip latch is released from the collar and the shaft return spring returns the pallet and firing shaft to their original position. The trigger should fire the piece just before the trip latch releases. When the handle is released the handle return spring throws it upward and resets the mechanism in the firing position. The piece may be fired by a lanyard attached directly to the trigger shaft of the breech mechanism, but should habitually be fired by the cradle firing mechanism.

TOP CARRIAGE.

The top carriage is built up of two cast-steel side frames riveted on the flange steel top-carriage bottom plate. The bottom plate lies under the lower flanges of the side frames and extends upward in front, forming a stiff connection for them. On the underside of the bottom plate is riveted the forged steel pintle socket. The pintle socket is flanged downward on its underside, the flange having a bronze bushing which acts as a seat for a corresponding flange on the pintle of the trail. The front and rear ends of the side frames are machined to form guides for engaging in the trail clips. The front guides have bronze liners screwed on them and engage in steel clips bolted to the trail, the rear guides engage in bronze trail clips riveted to the trail. Projecting lugs on the left-side frame in front of the rear guide form bearings for the traversing nut. On the rear face of the side frames are formed seats for the handwheel-shaft bracket on the left and the handwheel-shaft bearing on the right.

In the top of the side frames bearings are formed which support the bronze trunnion bushings. The trunnions of the cradle are seated in the trunnion bushings. The trunnion caps are hinged to the front of the bearings by the trunnion-cap pins and are secured by the trunnion-cap swing bolts at the rear of the bearings.

Near their forward ends the side frames are shaped to form vertical and parallel seats, to which the elevating gear cases, left and right, are bolted. Elevating worm bearings are provided in each side frame and afford seats for the worms of the elevating mechanism. The top carriage, complete, is regarded as one interchangeable piece.

The elevating mechanism consists of the rockers, rocker brace worms, elevating shaft, handwheel shafts, intermediate elevating shaft, and their accompanying parts.

The rockers, right and left, are made of forged steel. They are located on the trunnion bushings between the rim bases of the cradle trunnions and the trunnion bearings of the top carriage. The two rockers are bolted to each other by means of the forged-steel rocker brace. The latter passes under the howitzer and insures the action of the rockers as a unit. A bronze rocker washer is riveted to each rocker and affords a wearing surface between the rocker and the top carriage. A similar bronze wearing surface between the rockers and the rim bases of the cradle trunnions is afforded by flanges on the trunnion bushings. The trunnion bushings are keyed to the rockers rotating with them. The sight and quadrant bars rotate with the left and right trunnion bushings, respectively. Lugs on the extreme rear end of the rockers engage the pawls of the quick-return mechanism as hereafter described.

The worm teeth of the rockers engage the (Hindley) worms lying in the elevating worm bearings of the side frames.

The worm-bearing caps are bolted to the bearings. Bosses on the worm-bearing caps and on the rockers furnish elevating stops. Bevel gears on the forward ends of the worms engage pinions on the elevating shaft, which runs transversely across the top carriage. The right and left ends of the elevating shaft are journaled in the gear cases bolted to the side frames of the top carriage. The shaft passes through and supports the elevating gears on the outside at both ends. The elevating-gear covers bolted to the elevating-gear cases form with them housings for the elevating gears and the forward ends of the handwheel shaft, left, and intermediate elevating shaft. The bevel pinions on the forward ends of these shafts mesh with the elevating gears. On the right side, the intermediate elevating pinion on the rear end of the intermediate elevating shaft meshes with the gear integral with the handwheel shaft, right, the whole being housed in the handwheel shaft bearing, riveted to the right side frame.

When the handwheel shafts are rotated by means of either elevating handwheel, the gears transmit the action through the elevating shaft and the worms to the rockers forcing them to rotate about the trunnions, elevating or depressing the cradle.

The howitzer bears against the top carriage bottom plate at maximum depression, while at maximum elevation bosses on the rockers meet stops on the worm-bearing caps.

QUICK-RETURN MECHANISM.

The quick-return mechanism is designed to afford means of quickly returning the cradle and howitzer to the loading position and releasing them from the elevating mechanism without interfering with the laying of the piece or disturbing the setting of the sights and quadrant, thereby saving time in firing. The quick-return mechanism consists of the pawls, pawl handle, link, and latch, and accompanying parts of each. The pawls are hooks supported on bosses of the cradle head, rear, and connected through the cradle by the pawl shaft. The shaft is operated by the pawl handle, fulcrumed to the handle bracket on the right side of the cradle and connected to the right pawl by a link and latch. The link is slotted to allow engagement of the pawl and rocker without raising the handle to which it is pinned. The latch works with the right pawl in such a manner that it is engaged in the slot of the firing pallet collar, preventing firing by means of the firing handle when the pawls assume any position but that of complete engagement with the rocker. Pinned to the rear of the pawls are plunger rods working in guides riveted to the cradle. By means of pawl springs on the plunger rods between the guides and the pawls sufficient compression is exerted to keep the pawls locked to the rocker.

For quickly bringing the howitzer to the loading position when the pawls are released from the rockers an upward pull is applied to the pawl handle.

Safety depression stops are provided on the shield to check the downward motion of the cradle and prevent damage to parts of the valve-turning mechanism when by accident the pawls become disengaged from the rockers with the howitzer removed from the carriage.

TRAIL.

The flasks of the trail are made of flange steel, shaped and reinforced to form a box section. The reinforce plates are on the inside of the flasks and have lightening holes. The forward ends are connected by means of the flange-steel pintle plate. The latter forms a support for the pintle which engages in the corresponding part of the top-carriage bottom plate, or pintle socket, and is reinforced underneath by the pintle-axle plate. The trail flasks are also strengthened by the axle-reinforce plates, riveted to their front outside ends, and more securely held together and boxed in the top and bottom plates. At the forward end of the trail are two front trail clips bolted in place for engaging corresponding guides on the top carriage.

The axle is made in three parts—the two axle arms and the body. In assembling, the axle arms are forced onto the body of the axle.

The axle body has two flanges; it is connected to the flasks by rivets passing through these flanges, the sides of the flasks, and the reinforce plates. They are given a slight set from the horizontal to offset the dish of the wheel, so as to bring the lowest spoke in the wheel vertical when the carriage is limbered. Both the axle and the axle arms are bored out to reduce weight; the bore in the arms is closed at the inner end by the axle-arm plugs. The space thus created is used as a reservoir for lubricating oil. In rear of the axle between the trail flasks is a transom, called the traveling lock support, for pinning the lock in the firing position. The lock works to the front and rear in bearings riveted to the trail flasks.

For about half its length from the axle the trail is open to allow the howitzer to pass between the flasks when fired at the higher angles of elevation. At the middle, the flasks are connected and braced by the front transom. Below this are the middle and rear transoms and the float and spade. The top plate, riveted to the flasks and transoms, covers the lower trail and a bottom plate closes the underside of the trail between the front and the rear transoms. The front box, thus formed, is used as a tool box, the rear as a compartment for carrying the sight. These boxes are entered through flanged openings in the top plate which are closed by hinged covers. The covers are secured by a cover latch and padlock.

On the trail flasks, a brake segment is riveted to the front outer end of the right trail flask, and brake-shaft bearings are suitably located on both right and left flasks. A traversing pivot bracket is riveted to the left trail flask immediately in front and below the rear trail clip.

The spade is a flange steel piece riveted to the flanged ends of the flasks. Its ends are stiffened by being turned forward at right angles to its bearing surfaces and riveted to the float. The float is riveted to upper flanges of the flasks. The wings of the float project on either side of the spade in order to prevent the end of the trail from burying itself in the ground. A spade edge is riveted to the lower edge of the spade and serves as a wearing plate therefor.

Two trail handles, for use in limbering, and a lunette bracket are riveted to the top of the float. The lunette is secured to the bracket by a nut.

A handspike is mounted on a rib formed on the lunette bracket and when not in use may be folded forward over the trail. It is held in this position by a spring fastening riveted to the cover of the sight box.

Two seats for cannoneers serving the piece are rigidly attached to the trail, one on each side. Attachments for carrying the rammer and staves are riveted to the right flask. Wheel guards riveted to

the flasks protect them from wear of the limber wheels when making short turns.

A name plate, giving the number of the carriage, model, name of manufacturer, year of completion, and initials of inspector, is riveted on the top plate. *In all reports and correspondence, the carriage should be designated by the number and model given on the name plate.*

TRAVERSING MECHANISM.

The traversing mechanism consists of the traversing screw and handwheel, the traversing pivot, the traversing nut, the thrust-bearing nut, the ball thrust bearing, and the traversing-pivot bracket and their accompanying parts.

The bronze traversing pivot swivels on a vertical axis in the steel traversing-pivot bracket, the latter being riveted to the left trail flask. The upper part of this pivot is bored horizontally to form a housing for the ball thrust bearing.

The traversing nut, which is of bronze, swivels on a vertical axis in lugs on the top carriage side frame. The nut may be inverted in assembling and care should be taken to have the right side (as indicated by the handy oiler) assembled up. The traversing screw is threaded into the traversing nut with a left-hand thread and extends outward through bearings in the traversing pivot to the handwheel. When the handwheel is turned, the traversing nut is forced along the screw and carries the top carriage with it. Angular movement of the axis of the screw as the top carriage turns about the pintle center is allowed for by the vertical bearings of the nut and the pivot. The collar on the screw serves as a stop to limit the traversing movement of the rear end of the top carriage to the left, while a washer nut, assembled on the inner end of screw, limits movement in the opposite direction.

An azimuth scale is attached to the left rear clip of the trail and in conjunction with a zero mark on the top carriage guide indicates the position in azimuth. The scale is graduated to minimum readings of 5 millièmes.

AXLE SEATS.

Axle seats are provided on both sides of the howitzer in front of the shield. Each consists of the seat brackets, seat, seat-arm bracket, seat-arm guard, seat arm, seat supports, foot rests, braces, and several smaller connections.

The two seat brackets on each side of the howitzer are riveted at their rear ends to the bracket supports which are clamped to the axle. The front ends of the brackets are joined together by the flange-steel foot rest, which is braced and riveted thereto.

A shield-brace foot is riveted on the outside of the seat bracket, outer, near the foot rest, and forms a bottom connection for the lower shield brace. The lower shield brace is connected at its upper end to the five-armed bronze seat-arm bracket. The upper shield brace is attached at its lower end to the seat-arm bracket and at its upper end to the shield-brace bracket, bolted to the main shield. The seat arm is also secured to the shield-brace bracket and has its lower connection in the seat-arm bracket. The seat support (inside) is secured at one end to a seat-support foot, riveted to the seat bracket, inner, and at its other end to the seat-arm bracket. The seat support (outside) is secured at one end to a seat-support foot, riveted to the seat bracket, outer, and at its other end to the seat-arm bracket.

The flange-steel seat is riveted around the seat support (inside) at the front and bolted to the main shield at the rear. The seat-arm guard is riveted around the seat arm and shield brace.

A suitable cushion is provided for each seat.

The two seats are similar, excepting parts are right and left. The seat brackets have also riveted thereon small parts for the road brake and shield.

The apron-latch body is pivoted on the apron-latch base, riveted to each inner seat bracket. The lower end of the latch body terminates in a hook which engages the latch staple riveted to the apron plate and holds the latter in traveling position. To prevent accidental disengagement of the hook from the staple, the opening of the hook is closed by a plunger, seated in the latch body and pressed outward into position by a spring.

THE ROAD BRAKE.

The road brake consists of the brake beams, brake shoes, brake-beam fulcrums, brake-rod ends, brake rods, brake-rod springs, brake-spring covers, brake-spring cover ends, brake cranks, brake shaft, and brake lever.

The brake-beam fulcrums are riveted to the outer seat brackets and form bearings in which the brake beams are pivoted. The outer ends of the brake beams are fitted with brake shoes which bear against the wheel tires when operated. The inner ends of the beams slide in the brake-beam guides, riveted to the inner seat brackets. The brake-rod ends threaded to the brake rods are pivoted to the beams at their inner ends.

The brake-rod ends allow for adjustment of the bearing of the shoe in the tire. The brake rods are seated in the brake-spring cover heads, which are the front ends of the housings for the brake-rod springs. The brake-spring covers and brake-spring cover ends complete the housings. The brake cranks are pivoted to the rear

ends of the brake-spring cover ends and are assembled to the ends of the brake shaft on square seats. The brake lever consists of two arms integral with the right brake crank.

The brake shaft is mounted in bearings, riveted to the flasks of the trail. The brake lever is mounted on the extreme right end of the shaft and extends to the front and rear, affording means of operating the brake either from the front or rear of the shield. Each arm of the lever has a brake-lever catch riveted to it which engages in the segment rack on the brake segment in front and the segment rack of the right bracket support cap in the rear. The brake segment is riveted to the front end of the right trail flask. A forged steel hook is riveted to the brake lever and limits its lateral movement, and the brake segment is flanged into a hook at its lower end to stop the downward motion.

The operation of the brake is as follows: In applying the brake the brake lever is sprung in toward the segment rack, allowing the brake-lever catch to engage its teeth. A pull on the lever revolves the brake shaft and with it the brake cranks. The brake cranks, by means of the brake rods and the action of the brake-rod springs and their housings, force the inner ends of the brake beams forward, thus causing the outer ends to move backward toward the wheels.

By disengaging the brake lever from the segment rack the tension on the brake-rod spring is reduced and the brake rod is pulled to the rear, freeing the shoes from contact with the wheels.

Adjustment to compensate for wear of the brake shoes is secured by varying the distance the brake rods are screwed into the brake-rod ends. The tension on the brake-rod spring may be adjusted by varying the distance the brake-spring cover end is screwed into the brake-spring cover.

THE SHIELD.

The shield for the protection of the cannoneers is a hardened steel plate 0.15 inch thick, made in four parts, the apron, main shield (upper and lower halves), and top shield.

The main shield has a large opening through which the howitzer and cradle project and smaller openings for the lines of sight and the seat brackets.

The halves of the main shield are bolted together by means of the bracket supports. The main shield is bolted to the bracket supports, outer and inner, to which the seat brackets are riveted. The two flange-steel axle seats are bolted to the main shield. Diagonal shield braces are bolted on both sides of the howitzer opening and are secured to the diagonal shield-brace brackets, clamped about the axle. These braces and the shield braces, forming part of the support for the seat, stiffen the shield in position.

The lower edge of the main shield (lower half) extends to the bottom of the seat brackets. The apron is hinged to lugs cast on the seat bracket supports. The upper edge of the main shield is fitted with three hinges for the top shield.

The top shield is hinged to the main shield and is arranged so as to fold on the main shield in traveling. It is fastened in an upright position by the top shield fastenings, hinged to the top shield on the rear, and secured to the main shield by wing nuts. When folded, the wing nuts on the front of the main shield secure it in a locked position.

The apron extends to about 6 inches from the ground and for traveling is swung up toward the front and under the seat brackets, where it is held by the two apron latches. The port for the panoramic sight has an armor-plate shutter provided therefor, which is hinged on the top shield and may be held open by engaging the spring-shutter support in the open position on the shield. Cases are provided for the panoramic sight and range quadrant on the rear of the main shield. Safety depression stops are suitably located on the main shield.

THE TRAVELING LOCK.

To relieve the elevating and traversing mechanism from all strains in traveling, a traveling lock is provided by which the howitzer may be securely locked to the trail. The traveling lock is an irregular U-shaped piece pivoted at its ends to the traveling-lock bearings on the trail flasks. Its center has a yoke that slides over a boss on the howitzer and the parts are secured by the locking pin. When not in use, the lock is swung around to the front and secured by the locking pin to the traveling-lock clip, a bronze piece riveted to the traveling-lock support secured between the trail flasks.

THE WHEELS.

The wheels are a modified form of the Archibald pattern, 56 inches in diameter, with 3-inch tires. The hub consists of a forged-steel hub box and hub ring, each with flanges clamping the spokes and drawn together by eight carriage bolts. The hub band is screwed on the hub box and a lock washer is placed between it and the hub ring, preventing the band from unscrewing. The hub band should be screwed up as tightly as possible with a wrench and finally forced by striking the end of the wrench with a wooden block or mallet. The bronze hub cap is screwed on the hub box and locked to the hub band by the hub-latch plunger, which is withdrawn and held in a disengaged position by the hub latch when the hub cap is to be unscrewed. Assembled to the hub cap and projecting into the axle arm is the oil valve, by means of which the wheel is oiled without being removed.

The hub box is fitted with a bronze liner forced in place. The liners are removable. The tire is shrunk on the wooden felloe and secured to it by tire bolts.

The wheel fastening, a bronze yoke, fitting recesses in the end of the axle arm, secures the wheel to the axle and is exposed only when the hub cap is removed. The wheel fastening is secured to the axle by the wheel-fastening plunger.

DISMOUNTING AND ASSEMBLING HOWITZER AND CARRIAGE.

The sight and quadrant, with their bars and cross-wire holder bracket, should be removed and put in a safe place before any disassembling operations are undertaken.

To dismount the howitzer.—Remove the cylinder locking screw, unscrew the cylinder retaining ring on the rear end of the cylinder, partly remove the gun-lug plug, and draw the piece to the rear until the rails are free from the cradle-gun slides. To remove the cylinder retaining ring more readily it is well to use the spring compressor, retracting the howitzer about 2 inches, as the ring carries the weight of the springs on its threads for the first half inch or so.

To mount the howitzer.—Shove the piece from the rear, with the gun slides engaging the rails, guiding the cylinder carefully into the lug on the howitzer, taking care that the locating pin in the bore of the lug enters the notch cut on the exterior surface of the cylinder, opposite the vent plug. Assembling marks on howitzer and cylinder facilitate this operation. Assemble the cylinder retaining ring, locking it in place on the cylinder with the cylinder-locking screw and screw down the gun-lug plug.

In moving the piece on or off the cradle, particular care must be taken to support the breech end so that the howitzer rails are in prolongation of the cradle gun slides. The center of gravity of the howitzer is about 11 inches from the rear end of the rails. Balancing the howitzer at this place will assist in maneuvering it and will prevent any tendency to tumble. The firing pallet is exposed to injury during this maneuver, and care should be taken to prevent it from being struck by the muzzle of the piece or by implements in the hands of cannoneers. The cradle should be approximately horizontal, and at 0 azimuth before beginning either of these maneuvers and not changed during its progress, since the working of either of the elevating or traversing mechanisms, when the piece is partially out of battery, brings an excessive and unnecessary strain and wear upon the parts, and there is also danger of the howitzer sliding off to the rear with the gun slides elevated and the cylinder-retaining ring removed.

To dismount the cradle head, front.—Remove the piston-rod nut; release the three swing bolts securing the cradle head. The head may

then be drawn partially to the front; then elevate the howitzer to the maximum so that the connecting-rod pin, front, holding the connecting rod to the valve turning gear may be removed. The connecting-rod pin, front, is tapped with a left-hand thread to receive a cross-shaped socket wrench provided for convenience in handling this pin. With the nut, swing bolts, and pin removed, the head may be withdrawn to the front.

In assembling these parts be sure that the assembling marks on the valve-turning pinion and valve-turning gear coincide and that split pins for connecting-rod pins, front and rear, and for the taper pin of the collar on the gear are inserted.

To dismount the recoil cylinder.—The cradle should always be brought to zero elevation before the cylinder-retaining ring is removed. If the cylinder is to be dismounted without removing the howitzer, the howitzer should be securely lashed to the cradle to prevent movement to the rear. The piece having been brought to the horizontal position, the cradle head is removed. The cylinder-locking screw and cylinder-retaining ring in rear of the howitzer lug are taken off, the gun-lug plug is unscrewed, and the cylinder with piston rod, etc., withdrawn to the front. *Only those swing bolts affecting the front cradle head are to be disturbed. The two securing the spring retainer are only to be loosened when the spring compressor is in place and when it is desired to remove the springs.*

To assemble the recoil cylinder.—The springs, spring stirrup, and spring retainer being in assembled position, push the cylinder into its seat from the front, locating the notch for engagement on the pin in the howitzer lug from the rear by means of assembling marks engraved on the howitzer lug and cylinder end. This will place the filling and the vent plugs at the top. Screw in place the cylinder-retaining ring and secure it with the cylinder-locking screw.

Screw home the gun-lug plug.

Assemble the cradle head and screw in place the piston-rod nut. The nut should be screwed up securely, but not too tightly.

In replacing the cylinder it sometimes happens that the inner springs have become displaced in a way to prevent the entrance of the cylinder; in such a case reach in from the rear or front of the cradle and place the coil in its right location with a stick. Do not stand in front of the cradle during these operations.

To drain the cylinder.—Clean receptacles for holding 2 gallons of oil are to be provided. Remove the cradle head front, depress the howitzer to the maximum, open the vent plug at the rear, unscrew both filling and drain plugs from the front cylinder head. A duct should be improvised to lead the flow of oil beyond the muzzle, where it can be caught by the receptacles provided. The trail of the howitzer may be elevated about 6 feet off the ground, if necessary, to secure

proper drainage. If the cylinder is to be removed from the cradle, it may be completely drained when removed. Thorough draining may also be obtained, when the filling and vent plugs are not in a vertical line, by unscrewing the gun-lug plug and cylinder-retaining ring and slipping the cylinder sufficiently far to the front to disengage from the pin in the gun lug and then turning it until the filling and drain plugs are vertical. The cylinder is then held in the cradle by improvised means while the howitzer is depressed, trail elevated, and cylinder drained completely.

To fill the recoil cylinder.—*If the cylinder is not completely filled, loss of stability will occur and higher stresses than normal will be developed in the carriage; for this reason the cylinder should be filled with the greatest care; a commissioned officer should himself verify that the cylinder is full and that no air is left in it, with the exception of the void noted below.*

To fill the cylinder when assembled to the carriage proceed as follows: The piston rod, recoil valve, counter-recoil buffer, cradle-head front, and cylinder heads being assembled, depress the muzzle about 3° from the horizontal. Remove the filling plug with the socket wrench, attach the filling funnel through the cradle to the cylinder at the front end, remove the gun-lug plug and loosen the vent plug. Fill slowly until the oil flows, and not simply blows or bubbles out the vent-plug hole. When this is done, replace the filling and vent plugs. Depress the piece twice and place more oil in the cylinder. This process should be continued until it is certain that no pocketed air is in the female buffer, the by-pass, or between the valve and liner. When satisfied that the cylinder is entirely full, allow about 2 cubic inches (about one-sixteenth of a pint) of oil to escape, thus providing a void for the expansion of the oil. Tighten both the filling and vent plugs and replace the howitzer gun-lug plug. As filling is conducted at the front, special attention should be paid at the rear also to be sure that the vent and gun-lug plugs are screwed in place after the filling operations.

It may happen that after firing a few rounds the howitzer will not return to battery. This may be due to, first, weakness of springs; second, stuffing-box gland being screwed up too tightly; or, third, the oil having expanded, due to heat.

In any case the cause must be ascertained and remedied; if due to expansion of oil it is proven by the fact that the piece can not be pushed into battery by force exerted on the breech of the howitzer. In that case remove the gun-lug plug of the howitzer and loosen the vent plug with the piece horizontal, and allow the oil to run out. The oil will now escape, permitting the howitzer to return to battery.

Approximately $11\frac{1}{2}$ pints of oil are required for filling the cylinder. Hydroline oil of a specific gravity of 0.85 is furnished by the Ordnance

Department for use in these cylinders; it is characterized by its low freezing point and by its noncorrosive action on metals. The oil used in the cylinder is to be clean and free from grit and dirt; to insure this it is to be strained through a clean piece of linen or muslin before using.

In emergencies, water may be placed in the cylinder. *This should be done only when absolutely necessary and never in freezing weather, and as soon as practicable the cylinder is to be emptied, cleaned, thoroughly dried, and filled with hydroline oil.*

To dismount the springs.—With the cradle elevated, the breech lashed to the wheels and brake set, remove the cylinder-retaining ring, partly unscrew the gun-lug plug, and screw the retracting eye securely into the threaded recess in the rear end of the counter-recoil buffer. Special care should be taken to insure that the retracting eye is properly screwed on.

The spring-compressor block and tackle are attached by placing the hook of the single tackle block over a rope about the trail and engaging the hook of the double tackle block in a loop on the spring-compressor rope with the tackle rope passed through the blocks. The two blocks are brought to within about 6 inches of each other. The elevation of the cradle and the position of the supporting blocking should be such that when the rope is taut it will be in the center of the hole in the howitzer lug. By means of the spring-compressor rope and the block, put sufficient strain on the retracting eye to relieve the spring retainer from spring pressure. Remove the cradle head, front, then the spring retainer by loosening the swing bolts. Ease off the block until the springs are free. The stirrup and cylinder project out of the cradle about 5 feet when the springs are free, and blocks for supporting them should be arranged accordingly.

On account of the length of the free spring column, temporary blocking, if practicable, should be placed in front of and on a line with the bottom of the cradle to support the weight of the cylinder, stirrup, and springs, both in releasing and in assembling the column.

To assemble the springs.—With the cradle elevated, howitzer secured as directed for dismounting, and brake set, shove the first section of the outer springs into the cradle. Place the other spring section, the one which is bent or bowed the most on the spring stirrup, set the outer spring separator on the stirrup against it, and enter the rear end of the stirrup into the spring column in the cradle. Similarly assemble the springs of the inner column, one into the stirrup and one on the cylinder. The spring follower is run on the cylinder with the bevel to the front and the inner spring separator placed on the rear end of the cylinder. Extend the blocks as far as possible, screw the retracting eye securely into the buffer, passing

the end of the spring compressor to the rear through the spring column and cylinder-retaining ring. While the spring column is being compressed care must be taken to see that the rear ends of the cylinder and stirrup are properly guided through the rear cradle head, and that the inner coil does not catch the front of the spring stirrup and the outer coil, the front of the cradle. It may be necessary to displace the interfering coils laterally by tapping them with a hammer having a wooden buffer interposed in order to get the coil central. When the springs are sufficiently compressed the spring retainer is assembled. The spring compressor can then be released and disengaged, but should not be removed until the cylinder-retaining ring is assembled. Care should be taken that the retracting eye does not unscrew due to turning of the rope-spring compressor in retracting.

As the spring columns are assembled under a load of 750 pounds, serious results may attend a sudden release by breakage of the spring compressor or other parts during the process of compressing. All parts should be carefully inspected before using, and all members of the howitzer crew be required to keep arms and bodies away from the front of the column during these operations.

To dismount the piston and piston rod.—The cylinder is removed from the cradle and drained. The gland lock is released by the removal of one split pin and the gland slackened a few turns. Each carriage is furnished with two large wrenches, one of which fits the rear cylinder head and one the front of the cylinder. The rear cylinder head may be unscrewed and the piston and rod may be withdrawn from that end, or the front cylinder-head spanner may be applied and that head removed, and the piston and rod taken out toward the front. It is easier to disassemble from the front. If it be desired to dismount the valve, the front cylinder head is taken off as the valve is removed at that end. If the piston only is to be removed, it is best to break the joint in the cylinder exposed to the least internal pressure, i. e., that of the rear head. When either head of the cylinder is removed, the opening is to be closed immediately by returning the head or by using clean cotton cloths to prevent grit from blowing into the valve and cylinder-liner ports.

The cylinder liner screws into the cylinder from the front end and is locked by a plug at the rear end screwed through the cylinder wall. It is never to be disturbed outside of the machine shop, as each liner is forced in its seat and located individually by the lock, the notches in the rear of the cylinder being cut later to insure the exact position of the rows of cylinder-liner ports in relation to the keys of the valve. Each cylinder, cylinder liner and lock, and valve retainer is therefore considered collectively as one interchangeable piece.

In dismantling and assembling the cylinder heads, the cylinder is always to be held by the wrenches. It should never be held by clamping bars at its middle or by using a chain wrench, as its walls are thin and not intended to withstand such usage.

If the joints at the cylinder heads leak, the fiber gaskets should be soaked in warm oil for about five minutes before assembling to overcome the difficulty.

To remove the valve.—Unscrew the locking screw of the valve retainer and unscrew the valve retainer, using the wrench and valve-retainer tool provided. The valve may then be drawn out to the front. There is a collar on the front end of the valve to prevent improper assembling. Before assembling the valve be perfectly sure that it is clean. Special care should be taken to screw up the valve retainer shoulder to shoulder with the cylinder liner with assembling marks opposite, so that the hole for the locking screw of the retainer aligns with the corresponding hole in the cylinder liner.

In assembling the piston rod, the operations of dismantling are reversed. It ought not to be necessary to take out the stuffing-box packing.

The necessity for dismantling parts of the cylinder will seldom arise. It is to be done only in the presence of a commissioned officer, who will see that the parts are handled with the greatest care. In assembling, the parts are to be thoroughly cleaned, as the clearances in the valve are very small and the presence of small foreign particles may interfere with the proper working of the parts.

To pack the stuffing box.—The stuffing box is packed with four rings of Garlock hydraulic waterproof packing 0.25 inch square, issued in rings cut to such size that the ends meet around the rod when packed. These rings are placed in the front cylinder head with ends cut to give a space of about one-sixteenth inch around the rod, each ring being placed so as to break joints with the preceding one and each in succession being forced into its seat by a packing tool of copper or hard wood. One end of this tool is shaped like a carpenter's gouge, while the other end is formed into a handle strong enough to withstand light taps from a hammer. Such a tool may be readily improvised by the battery mechanic. After the four rings are firmly seated in the chamber the gland is screwed on.

Be sure that at least $4\frac{1}{2}$ threads of the gland are engaged with the threads of the cylinder head, as otherwise the threads of the gland may be stripped in firing.

The adjustment of the gland will require exercise of some judgment. If screwed up too tightly the frictional resistance of the packing on the piston rod will be so increased that the counter-recoil springs may fail to return the howitzer to battery, especially at high

angles of elevation, or the valve-turning mechanism may be strained. *It is to be screwed up just tight enough to prevent the leakage of oil.* Ordinarily this can be done by hand, but where hand power is not sufficient the wrench provided for the purpose should be used. When adjusted, the gland is to be locked.

To assemble and disassemble the valve-turning mechanism.—The valve-turning gear and the valve-turning pinion assembled in the cradle head are always to be engaged with their assembling marks coinciding. The seat for the piston rod in the valve-turning pinion is so arranged as to admit assembling in but one position as the round shaft has flats on three sides, which arrangement, together with the assembling marks of the gears and the keying of the valve to the piston rod, insures the correct alignment of valve and cylinder liner. To remove the valve-turning gear from the cradle head, it is necessary to dismount the cradle head as described under "*To Dismount the Cradle Head, Front.*" The connecting-rod pin, rear, and the connecting-rod nut are then removed, and the connecting rod may be withdrawn to the front. The valve-turning pinion may now be removed by running the gear out of engagement and pulling the pinion to the rear. The gear may be removed by pulling out the split pin and removing the taper pin from the collar on the horizontal arm of the gear and pulling the gear toward the center of the cradle head.

The slide on the outside of the right trunnion band moves with the connecting rod. It is not necessary to remove the slide to take out the connecting-rod, although after the connecting rod is removed the slide may be run off. The removal of the springs is not necessary for dismantling the valve-turning mechanism.

In assembling, the connecting rod should be worked through the slot in the cradle plate and the slide put on afterwards. The slide can not be readily assembled with the cradle in any other position than at approximately maximum depression.

To dismount the traversing mechanism.—The washer nut is removed from the traversing screw, the split pins from the traversing-bearing cap screws, and the cap screws removed. The right trail clip is taken off and the top carriage then thrown around to clear. The nut is removed from the traversing pivot and the screw and handwheel withdrawn.

To dismount the seat brackets and shields.—Supports should be placed and blocks wedged up under the seat brackets to take the weight. The 10 bracket-support bolts fastening the bracket supports to the axle are taken out. The two diagonal shield-brace bolts are to be removed and the two axle stud nuts. The trail may be lifted and the carriage run slowly to the rear, or the seat brackets

and shield may be lifted and removed to the front. Care should be taken that the cradle passes through its port in the shield without getting caught.

If parts of the shield are to be disassembled, it is only necessary to remove the bolts holding these together. In assembling, be sure to have the heads of bolts to the front. For succeeding operations—that is, the removal of the cradle and the top carriage—it is necessary to remove only the upper half of the main shield, accomplished by the removal of four bolts through axle brackets near the seat, two diagonal shield-brace bolts, two bolts at the shield-brace bracket, and then to carry the shield forward over the muzzle.

To dismount the cradle.—The howitzer and upper main shield are dismounted, the connecting-rod pin, rear, disconnected from the right trunnion cap, the trunnion-cap swing bolts loosened, and the caps swung open; the cradle and rockers may then be lifted upward and to the rear from the top carriage as one piece.

To dismount the top carriage.—The howitzer, upper main shield, cradle, and traversing gear are dismounted. The front trail clips are removed and the top carriage may then be traversed to the left until free from the trail rear clips.

To dismount the elevating mechanism.—Note that the worms can not be assembled or disassembled while the rockers are engaged or with the top carriage assembled to the trail, as the nuts for the worm-bearing cap bolts are underneath. The right and left worm-bearing caps are removed and the worms dismounted. Remove the elevating-gear covers. The nuts from each end of the elevating shaft are removed. Remove the handwheel-shaft bearing and release the intermediate elevating shaft from the elevating gear. The cap of the handwheel-shaft bearing may be removed, if desired. Remove the elevating gear, right. Take the four bolts out and remove the elevating-gear case, right. Take the split pins out of the elevating pinions and move the shaft to the right, allowing the pinions to slide on the shaft until the left end of the shaft clears the left side frame of the top carriage, then draw the shaft out to the left through the opening in the top carriage. To remove the handwheel shaft, left, take the bolts off the handwheel-shaft bracket and lift the parts from the carriage.

To assemble the elevating mechanism.—Note that both rockers must elevate simultaneously, and to do so the following points are observed in the manufacture: The threads on the worms are in exactly the same relative position; the teeth of bevel gears are integral with the worm and in fixed relation to the thread; and the teeth of the elevating-shaft pinions have assembling marks thereon to match with the assembling marks on the bevel gears of the worms. Of the three steel washers on the elevating shaft, one lies between the right

elevating gear and the case and the other between the left elevating gear and case, and one between the right pinion and case.

With the right pinion on the shaft, place the end of the elevating shaft with the long flats on its periphery to the right, through the hole for the right elevating gear case. Then assemble the left pinion and place the left end of the shaft in its bearing in the left elevating gear case. Replace the elevating gears and nuts and the elevating gear case, right. Assemble the handwheel shafts and right intermediate elevating shaft and replace the elevating gear covers.

To dismount the firing mechanism.—Withdrawing the taper pin securing the collar on the forward end of each shaft allows the shaft to be withdrawn to the rear. In assembling, tension is put upon the springs as the firing handle hub is assembled.

To remove the road brake.—With split pins removed, the fulcrum pins can be driven upward from their seats, the brake-rod pins removed from the brake rod, and the brake beams, being then free, removed from the carriage. The brake rods are dismounted by removing the pins which attach their rear ends to the brake cranks. The brake shoe is freed from the brake beam by removing the brake-shoe tap bolts. The brake crank and brake lever are free on the brake shaft when their split pins are withdrawn, and the brake shaft can then be withdrawn through the holes in the bracket supports. To assemble the brake the operations just described are reversed. The brake beams are rights and lefts and are properly assembled when the shoes have full bearing upon the tires.

To adjust the road brake.—The brake rods are disconnected from the brake beams. The brake shoes are placed with the desired clearance from the tire and the brake lever in extreme forward (released) position. The lengths of the brake rods are then adjusted to correspond. If a test shows that one shoe bears harder against its wheel than the other, the brake rod of the latter is lengthened. It must be noted that some wheels are more or less out of round and the adjustment is not the same for all points along the tire.

To remove a wheel.—Support the axle to bring the wheel clear of the ground. Lift up the flap of the hub latch, thus disengaging its bolt, and unscrew the hub cap; the wheel fastening, which is now exposed, is secured to the axle by a spring pin in one side; when this is pressed back the wheel fastening may be lifted free and the wheel slipped off.

To remove a hub liner.—Take the wheel from the axle and drive the liner out by striking with a heavy hammer or sledge upon a suitable wooden or metal block placed against the small end of the liner. A hub-liner driving tool is carried in the forge limber for this purpose. In assembling a new liner, be sure the surfaces are perfectly clean and that no dust gets under the flange of the liner to prevent its being driven solidly against the face of the hub. Unless the liner is forced

completely into the hub, the distance from the face of the liner to the small end of the hub may be too great to allow the assemblage of the wheel fastening. Should the outer end of the liner project beyond the small end of the hub it may be filed flush.

The parts of this carriage in general are made with sufficient clearance to permit the assemblage of any part without the use of force. In assembling them no part should be directly struck with a hammer. If resort to force is necessary, a piece of wood or copper drift should be interposed between the hammer and the part struck. Most of the nuts and pins are provided with split pins as keepers. The split pins must, of course, be removed to remove the nut, and when the nut or pin is assembled the split pin should be inserted and properly opened.

CARE AND CLEANING OF RECOIL CYLINDER AND OTHER PARTS OF THE CARRIAGE.

The carriage is a machine for controlling the recoil of the howitzer and should be properly cleaned and cared for to insure its working correctly. The officers responsible for the efficiency of the battery should familiarize themselves with the carriage mechanism and with the foregoing instructions as to the methods of mounting and dismounting the various parts, and should see that the carriage is properly handled, cleaned, and cared for. The following general directions for its care and cleaning are given:

The recoil cylinder should be emptied and refilled once every three months. *Immediately before firings the carriage should be examined to see that no oil has escaped from the cylinder, and that it is in condition for firing.* The piston and recoil valve should be examined every six months (or oftener if conditions require it) for rubbing or scoring of the inside of the valve or piston. If such roughening be noted, the roughness is to be carefully smoothed down by a skilled workman with a dead smooth file or with fine emery cloth; the cause of roughness should be ascertained and removed. To prevent chips and emery from entering the cylinder liner ports, work on the valve should always be done with the valve removed from the liner. When unusual rubbing or scoring has occurred, the facts will be reported to the officer of the Ordnance Department charged with the duty of keeping the battery in repair, for his information and action. Before reassembling, the recoil valve, cylinder liner, piston, counter-recoil buffer, and the stuffing box should be thoroughly cleaned by the use of cotton cloths and coal oil and wiped dry. The use of cotton waste, especially in the cylinder liner, is not recommended, as particles of waste will work into the ports. The removal of the packing is not necessary in cleaning the stuffing box.

The parts are to be reassembled immediately after their cleaning and inspection and the cylinder filled with the hydroline oil issued

for that purpose. The piston should be moved back and forth and rotated by hand to make sure that all parts are correctly assembled and without interference. After the cylinder is mounted in the cradle the howitzer should be pulled from battery by hand twice and permitted to counter recoil rapidly to insure that all parts are in proper position for firing. The first time the howitzer should be retracted only 18 inches and permitted to counter recoil rapidly. If all parts function satisfactorily it should then be retracted 40 inches and allowed to counter recoil as a final test. This *should never be done, however, unless the cylinder is known to be filled with oil.* In reassembling the parts the condition of the fiber washers between cylinder heads and cylinder should be noted; they should be replaced whenever necessary.

In removing and inserting the piston and piston rod care should be taken to keep it central in the cylinder, so as not to bind, burr, or spring any parts. The dismounting and reassembling of the parts of the cylinder should in every case be supervised by a commissioned officer. Before firing an inspection should be made to ascertain that the different parts, especially the piston and piston rod and nut, are correctly assembled.

The recoil-cylinder oil should be stored in the closed cans provided for the purpose, and be carefully protected from dirt, sand, or water. Oil withdrawn from cylinders and containing any sediment must not be used again for any purpose until it has been allowed to settle for not less than 24 hours. When sediment has thus been permitted to settle, great care must be taken not to disturb it in removing the oil. To insure the cleanliness of all cylinder oil it should be strained through a clean piece of linen or muslin before using.

The counter-recoil springs should be dismounted at least once every six months and be thoroughly cleaned. All rust should be removed and the springs well oiled before assembling. When the springs are dismounted the interior of the cradle should be cleaned and examined for defective riveting, missing rivet heads, and scoring. The stirrup should be carefully examined for bulged or cracked ends, and all burrs or scores on the bronze inner and outer rings carefully smoothed off.

The gun slides should be kept well lubricated. Immediately before beginning to fire they should be oiled through the oil holes on the sides of the cradle. Lack of proper lubrication of the gun slides is the most frequent cause of failure to return fully into battery.

In traveling the howitzer should be locked to the trail by means of the traveling lock, so as to relieve the pointing mechanisms of all travel stresses. After the howitzer is so locked the pawls should be released and the rockers elevated until the pawls are clear.

The wheels and wheel fastenings should be dismounted periodically and the fastenings, hub boxes, axle arms, and axle bore cleaned

and examined. All roughness due to scoring or cutting should be smoothed off.

The hollow part of the axle acts as a reservoir for the oil to lubricate the wheel bearings. Experience will show how much oil is needed, but enough should be used to insure that the oil will pass through the axle arms to the hub cans.

The nuts on the hub bolts should be tightened monthly during the first year of service and twice a year thereafter. The ends of the bolts should be lightly riveted over to prevent the nut from unscrewing. When the hub bolts are tightened, the hub band should be screwed up as tightly as possible against the lock washer at the outer end of the hub ring.

The wooden parts of the wheels are made of thoroughly seasoned materials, and the hub bolts and bands, when the wheels are issued are properly tightened; but all wood is susceptible to change with atmospheric conditions, so that the spokes speedily become loose, and if the wheel is used in this condition it will rapidly be made unserviceable and may be damaged beyond repair.

In requests for spare parts for repairs and replacements it should be noted that practically all parts of the howitzer carriage, and other vehicles have symbols stamped thereon. Special care should be exercised in furnishing these symbols and the correct names given under the nomenclature of parts in requisitions, otherwise considerable delay may ensue, due to correspondence in an endeavor to fill requisitions correctly.

Special attention is invited to the provisions of paragraph 2, War Dept. G. O. 28, 1913. It is desired whenever matériel requires repair or alteration, or gives evidence of weakness or of being unsatisfactory report to this effect should be made to the ordnance officer charged with the care of the matériel before any other action is taken. This procedure will keep the Ordnance Department in better touch with the service point of view, particularly with reference to the defects and unsatisfactoriness in the matériel, and will, moreover, insure a proper and immediate remedy, and avoid the destruction of valuable property.

The importance of strict compliance with these rules can not be overestimated.

THE 3.8-INCH HOWITZER LIMBER, MODEL OF 1915.

[Plate X.]

WEIGHTS, DIMENSIONS, ETC.

Weight, complete, empty.....	pounds..	1,000.
Weight of tools and equipment carried.....	do.....	111.
Weight of ammunition carried.....	do.....	819.
Weight, completely equipped and loaded.....	do.....	1,930.

Rounds of ammunition carried in limber chest.....	number..	24
Diameter of wheels.....	inches..	56
Width of track.....	do.....	60
Free height under limber (and caisson).....	do.....	20
Turning angle.....	degrees..	74
Distance from center of limber axle to center of caisson axle when limbered (wheel base).....	inches..	117.5

NOMENCLATURE OF PARTS.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
2	Wheels and wheel fastenings.....	Same as on carriage.....	IV	
1	Axle.....	.....	
1	Ammunition chest complete, consisting of—	.....	
1	Ammunition chest front.....	Riveted to top and bottom plates.....		
1	Ammunition chest plate, bottom..	Bottom of chest.....		
1	Ammunition chest plate, top.....	Top of chest.....		
1	Ax-handle support.....	On chest front.....		
1	Ax-head pocket.....	do.....		
1	Blanket-holder front plate.....	Riveted to chest top plate.....		
4	Blanket-holder doorplate hinges, female.	Riveted on blanket-holder front plate.....		
4	Blanket-holder doorplate hinges, male.	Riveted on blanket-holder lid.....		
4	Blanket-holder hinge pins.....	In hinges.....		
1	Blanket-holder lid.....	Forms seat for cannoneers.....		
1	Blanket-holder rear plate.....	Riveted to chest top plate.....		
1	Blanket-holder transom, outer (right).	do.....		
1	Blanket-holder transom, outer (left).	do.....		
1	Blanket-holder transom, middle...	do.....		
2	Chest gussets.....	Inside chest front over side rails.....		
2	Door hinges, female (right).....	Riveted to top and bottom plates.....		
2	Door hinges, female (left).....	do.....		
1	Diaphragm brace (right).....	Between front and rear diaphragms.....		
1	Diaphragm brace (left).....	do.....		
1	Front diaphragm.....	Riveted to top and bottom plates.....		
2	Handrails.....	On handrail brackets.....		
2	Handrail brackets (right).....	Riveted to blanket-holder lid.....		
2	Handrail brackets (left).....	do.....		
1	Hatchet blade bracket.....	On left side of chest.....		
1	Hatchet-handle support.....	do.....		
1	Lantern bracket, complete, consisting of—	.....	
1	Lantern-bracket body.....	On chest front.....		
1	Lantern-bracket bottom.....	do.....		
2	Lantern-bracket strap fasteners.	do.....		
1	Lantern-bracket support.....	do.....		
1	Latch-pin plate, upper.....	Under top plate, at middle in rear of rear diaphragm.		
1	Latch-pin plate, lower.....	On bottom plate, at middle in rear of rear diaphragm.		
1	Lid-prop base.....	Riveted to blanket holder middle transom.		
1	Lid-prop hinge.....	Riveted to blanket-holder lid.....		
2	Lid-prop hinge rivets.....	.....	
1	Lid-prop link, long.....	Attached to lid-prop base.....		
1	Lid-prop link, short (right).....	Attached to lid-prop hinge.....		
1	Lid-prop link, short (left).....	.....	
1	Pick mattock guard, chisel end...	On left side of chest.....		
1	Pole-prop bracket.....	Riveted to blanket-holder rear plate.....		
1	Pole-prop stop.....	do.....		
1	Pole-prop strap-fastener liner.....	A filler under one of the strap fasteners.....		
26	Projectile tubes.....	Between front and rear diaphragms.....		
6	Reinforce pieces, long.....	On projectile tubes.....		
26	Reinforce pieces, short.....	do.....		
1	Rear diaphragm.....	Riveted in chest.....		
1	Shot bolt (right).....	In shot-bolt bracket.....		
1	Shot bolt (left).....	do.....		
1	Shot-bolt bracket (right).....	Riveted to blanket-holder rear plate.....		
1	Shot-bolt bracket (left).....	do.....		
2	Shot-bolt fastenings.....	On rear of bucket-holder lid.....		
2	Shot-bolt stops.....	Assembled with shot-bolt brackets.....		

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Ammunition chest complete, consisting of—Continued.			
2	Ammunition-chest doors, complete, consisting of—			
12	Cartridge-case tube (right).....	Between door diaphragms.....		
12	Cartridge-case tube (left).....	do.....		
24	Reinforce pieces, long.....	On cartridge-case tubes.....		
24	Reinforce pieces, short.....	do.....		
1	Door bearing plate.....	Riveted to right door diaphragm, front.....		
1	Door-diaphragm front (right).....	Riveted to doorframe.....		
1	Door-diaphragm front (left).....	do.....		
1	Door-diaphragm, rear (right).....	Riveted to doorplates.....		
1	Door-diaphragm, rear (left).....	do.....		
1	Doorframe (left).....	About left door.....		
1	Doorframe (right).....	About right door.....		
2	Door handles.....	On doorplates.....		
8	Door-handle reinforces.....	Washers under door handle rivet heads, inside.....		
2	Door hinges, male (right).....	Riveted on doorframes.....		
2	Door hinges, male (left).....	do.....		
4	Door-hinge pins.....	In door hinges.....		
1	Doorplate (right).....	Rear plate of door.....		
1	Doorplate (left).....	do.....		
1	Dust shield.....	On top of right door.....		
1	Fastening eye.....	On doorplate, left.....		
4	Filler pieces.....	Inside doorframe at hinges side of door.....		
1	Lock bar.....	In bearings.....		
1	Padlock with bolt snap, chain, 2 chain rings, and rivet.....	On lock bar.....		
1	Lock-bar bearing (right).....	Riveted on left door.....		
1	Lock-bar bearing (left).....	do.....		
4	0.125 x 0.796 ($\frac{1}{4}$) pins.....	In lock-bar bearings.....		
1	Lock-bar bearing cap (right).....	Assembled to lock-bar bearings.....		
1	Lock-bar bearing cap (left).....	do.....		
4	Lock-bar bearing studs.....	Secure lock-bar bearing caps.....		
2	Lock-bar pivots.....	In lock-bar bearings.....		
2	Lock links.....	Assembled in left door.....		
3	Projectile stops, long (right).....	Riveted to door diaphragms, front.....		
3	Projectile stops, long (left).....	do.....		
1	Projectile stop, medium (right).....	do.....		
1	Projectile stop, medium (left).....	do.....		
1	Projectile stop, short (right).....	do.....		
1	Projectile stop, short (left).....	do.....		
1	Shot-tongs handle fastening.....	On right door.....		
1	Shot-tongs pocket.....	do.....		
1	Shot-tongs stop.....	do.....		
1	Wing nut.....	Secures lock bar to doorplate, right.....		
1	Wing-nut pin and washer.....	Doorplate, right.....		
1	Doubltree, complete.....	On doubltree bolt.....		
	Consisting of—			
2	Double hooks.....			
1	Doubltree body.....			
1	Doubltree reinforce piece.....			
1	Nipple.....			
1	Nipple nut.....	Riveted together.....		
1	Nipple separator.....			
14	Rivets.....			
10	Separators.....			
4	0.375 x 1.687 ($\frac{1}{4}$) screws.....	Hold double-hook on doubltree.....		
2	Doubltree rods, complete.....	Connect doubltree to tie rod clamps.....		
	Consisting of—			
2	Rods.....			
2	Chains.....			
2	Chain links.....			
2	Doubltree rod pins.....	Secure doubltree rods to tie rod clamp.....		
1	Frame, complete, consisting of—			
1	Doubltree bolt.....	On pole clamp.....		
1	Doubltree strap.....	Riveted to middle rail, upper half.....		
1	Foot rest.....	Riveted to side rails.....		
2	Foot rest plates.....	Support forward ends of doubltree rods.....		
1	Foot rest support (right).....	Braces foot rest to middle rail.....		
1	Foot rest support (left).....	do.....		
1	Middle rail, upper half.....	Riveted to axle.....		
1	Middle rail, lower half.....	do.....		
1	Washer.....	Between halves of middle rail at pole seat.....		
1	Middle rail shim.....	Between middle rail and chest.....		
1	Name plate.....	On middle rail over pintle.....		
1	Pick handle fastener.....	Riveted to foot rest.....		

IV

3

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Frame, complete, consisting of—Con.			
1	Pick head fastener.....	On left side of foot rest.....		
1	Pick mattock point guard.....	do.....		
1	Pintle bearing, in two parts.....	Assembled in middle rail.....		
1	0.75 x 4.375 bolt.....	In pintle bearing.....		
1	0.75 x 3.625 bolt.....	do.....		
1	Pintle spring.....	Seated in pintle bearing.....		
1	Pintle spring pin.....	Secures pintle spring.....		
1	Pole clamp.....	Encircles middle rail at forward end.....		
1	0.75 x 4.062 ($\frac{41}{64}$) bolt.....	In pole clamp.....		
1	Pole pin.....	Secures pole in pole seat.....		
1	Pole pin reinforce.....	Riveted to middle rail, lower half.....		
1	Pole stop.....	At rear end of pole seat.....		
1	Prop bracket.....	Underneath pole clamp.....		
1	Prop chain button.....	Riveted to foot rest.....		
1	Prop chain button rivet.....	Secures button.....		
1	Shovel pocket.....	Riveted to left side rail.....		
1	Side rail (right).....	Riveted to axle.....		
1	Side rail (left).....	do.....		
1	Side rail shim (right).....	Between side rail and chest.....		
1	Side rail shim (left).....	do.....		
1	Tie-rod clamp right.....	On axle.....		
1	Tie-rod clamp (left).....	do.....		
2	Tie rods, front.....	From tie rod clamps to ends of middle rail.....		
1	Tie rod, rear (right).....	do.....		
1	Tie rod, rear (left).....	do.....		
6	Tie-rod pins.....	Secure tie rods.....		
1	Limber prop, complete.....	Assembled to middle rail by means of pole clamp eye.....		
	Consisting of—			
1	Prop chain.....	Secured to prop foot.....		
1	Prop-chain handle.....	On chain.....		
1	Prop-chain fastening.....	Attaches chain to prop tube.....		
1	Prop eye.....	Assembled with prop bracket of pole clamp.....		
1	Prop foot.....	At lower end of prop tube.....		
1	Prop tube.....	Body of prop.....		
1	Pintle, complete, consisting of—		IV	3
1	Pintle.....	In pintle bearing.....		
1	Pintle latch.....	On horn of pintle.....		
1	Pintle latch pin.....	Secures pintle latch to pintle.....		
1	Pintle latch spring.....	Assembled in pintle.....		
1	Pole, complete, consisting of—			
1	Pole body.....			
1	Pole plug.....	Riveted in body.....		
1	Neck-yoke counter stop spring.....	Bears on neck-yoke counter stop.....		
1	Neck-yoke counter stop pin.....	Riveted in body.....		
1	Neck-yoke counter stop.....	Hinges on counter stop pin.....		
1	Neck-yoke stop.....	Riveted to body.....		
1	Neck-yoke chafing plate.....	Riveted to upper side of body.....		
1	Neck-yoke stop separator.....	Inside of body.....		
1	Neck-yoke stop rivet separator.....	do.....		
1	Pole pin bushing.....	do.....		
1	Butt reinforce.....	Riveted to inside of body.....		
	Strap fasteners:			
1	Ax strap.....	On front of chest.....		
3	Grip strap.....	do.....		
1	Hatchet handle.....	On side of chest.....		
2	Pick head.....	On foot rest.....		
8	Picket rope.....	On front of chest.....		
2	Pole prop.....	Riveted to blanket holder rear plate.....		
1	Shot tongs.....	On top of door.....		
1	Shovel handle.....	On foot rest.....		
	Crown nuts (standard).			
8	0.375-inch.....			
1	0.625-inch.....			
4	0.75-inch.....			
	Split pins.			
9	0.156 ($\frac{1}{16}$) x 1 inch.....			
2	0.156 ($\frac{1}{16}$) x 1.75 inch.....			

DESCRIPTION OF THE LIMBER.

[Plate X.]

The limber is a two-wheeled vehicle provided with an ammunition chest for the transportation of ammunition for the 3.8-inch howitzer, models of 1908 and 1908 M1. It is made of metal throughout excepting the spokes and felloes of the wheels. The principal parts are the wheels, axle, ammunition chest, frame, pintle, pole, limber prop, doubletree and singletree, and neck yoke.

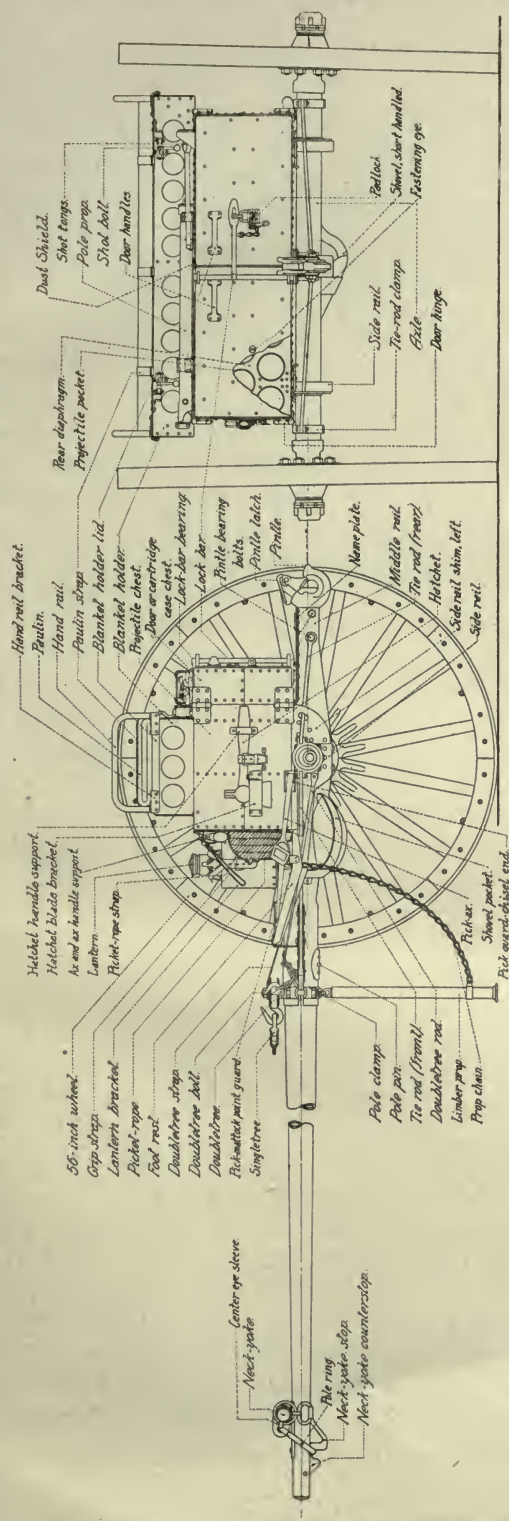
The wheels and wheel fastenings are the same as and interchangeable with those on the carriage. The axle is square in section, forged from a single piece of steel.

The ammunition chest is built up of flange steel having a top plate and a bottom plate joined at the sides of the chest. The front plate is flanged all around and has vertical corrugations in it for additional stiffness. The flanges are riveted to the top and bottom plates. The flange steel gussets brace the front plate above the side rails to the bottom plate. The bottom plate is reinforced at the points of riveting to the frame at the front by means of the flanges on these gussets and at the rear by means of the flanges on the diaphragm braces which connect front and rear diaphragms. Shims are placed along the whole depth of the chest above the middle and side rails. The side-rail shims pass in rear of the square axle to afford additional stiffness to the chest bottom and side rails.

Inside the chest are located two vertical diaphragms—one front and one rear—flanged all around and riveted to the chest. They are perforated with 26 holes each, designed for projectiles. Twenty-four projectiles are carried. Two holes are used for oil cans. Corresponding diaphragm holes are connected, front and rear, by projectile pockets of half-hard brass, rolled in, in assembling. These serve to guide the projectiles and stiffen the diaphragms.

The perforations in the rear diaphragm are made conical, and after the projectile pockets are seated these cones fit the taper of the rotating bands of the projectiles, forming stops for the same. Each tube or pocket in the limber chest has its ends crimped over the flanges of the perforations and has beads expanding against both diaphragms, thereby securing it in position.

A blanket holder or seat is attached to the chest top plate. It consists of three transoms, forming with a front and a rear plate as supports two compartments, a blanket-holder lid hinged to the front plate, and other parts attached thereto. The lid is held in the open position by a folding lid prop hinged to the middle transom and in the closed position by two shot bolts engaging in shot-bolt fastenings on the rear end of the lid. Handrail brackets riveted to the lid support handrails at the right and left sides of the vehicle.



38-Inch Howitzer Limber, Model of 1915



The top and bottom plates of the chest extend to the rear, forming a hooded seat for the two doors.

The two doors have projectile stops riveted to their front diaphragms along the sides of the holes for the cartridge cases which overlap the holes in the limber chest for the projectiles. These projectile stops bear against the base of the projectiles when the door is closed; the cartridge cases in turn bear partly against the rear end of the projectiles. This arrangement holds the projectiles and cases firmly in place with the doors closed.

The doors are two small chests similarly built. They consist of front and rear diaphragms and a door plate held apart at the proper distance by a flange-steel sheet, the door frame, bent and riveted about them, the latter constituting the top, bottom, and sides. Twelve cartridge-case pockets connect corresponding front and rear diaphragm holes of each door. The doors are each hinged by two hinges to the sides of the chest body to swing open to the rear. Two door handles are riveted, one to the upper edge of each door, near the center of the limber chest.

In the locked position the doors are held by a lock bar hinged to the left door and locked by a hasp on the lock bar to a wing nut, provided with a padlock, on the right door. The shaft of the lock bar is pivoted at both top and bottom and has eccentric bearings which fit into corresponding holes of the door-lock hooks (lock links). The links are slotted with a cammed seat for a stud in the lock-bar bearing; the arrangement is such that rotation of the lock-bar shaft causes the cam in the shank of the hooks to move along the stud of the bearing and this fulcrum action forces the hook end transversely about studs on latch-pin plates, riveted to the top and bottom plates of the chest, locking the doors in place. This eccentric and cam action causes the lock links to work backward and forward, also facilitating the opening and closing of the doors, as the action forces the hook against the rear diaphragm of the chest, pressing the left door out in opening and pulling inward on the left door in closing.

The right door has a lip flanged on the left side of the door frame at the front, against which bears the door bearing plate riveted on the left door diaphragm front. This lip prevents the doors jarring open on the road as long as the hooks of the lock links are engaged, even if the lock bar itself is partly released.

The frame consists of a middle rail and two side rails, a foot rest, and necessary braces. The chest is placed across the middle rail and side rails and each end is braced on the square axle by the side rail shims riveted to the chest bottom and the outside of the side rails. The axle passes through the middle rail, which is flanged to receive it. The flange-steel side rails are also shaped to receive the axle, which has three lugs riveted to each rail. At the front of the

chest the side rails are inclined upward and support the ends of the perforated flange-steel foot rest. By means of the foot-rest supports the foot rest is braced at its front to the middle rail and has riveted at each side foot-rest plates which support the doubletree rods.

The middle rail consists of two parts, riveted together through the middle rail shim to the chest bottom. The front end of the middle rail is formed into a circular pole socket and fitted with a pole clamp, doubletree bolt, doubletree strap, pole stop, and pole pin. The pole clamp is a steel collar split on one side and provided with a clamping bolt for drawing the two halves of the middle rail firmly about the pole. At the bottom of the pole clamp is riveted the prop bracket, into which an eye of the limber prop swivels. The prop consists of steel tubing with a bronze foot, and is held in the traveling position by means of a chain passing through a perforation in the foot rest with a prop chain handle fitting over a prop chain button riveted to the foot rest. A seat for the doubletree is formed on top of the pole clamp. The doubletree bolt, the upper end of which is threaded for a nut, projects up through this seat and the doubletree and is braced back to the middle rail by the doubletree strap.

The rear end of the middle rail is a seat for the bronze pintle bearing, which is made in halves and bored out to take the pintle shank. The two halves of the bearing, with the pintle in its seat, are assembled and held in the rear end of the middle rail by two pintle-bearing bolts. The pintle has a swiveling motion of 360° upon its shank, but is kept in its normal position by the pintle spring contained in the pintle bearing and bearing upon a flattened seat on the front end of the shank. The lunette is retained upon the pintle hook by a pintle latch. The latter is pivoted by the latch pin upon the end of the pintle horn and is arranged to be held in either the open or closed position by the pintle-latch spring. The latch is opened by the lunette in entering it upon the pintle hook, but must be closed by hand. The spring is peened in its seat, but may readily be driven out and a new one inserted, if required.

Tie-rods are pinned to lugs on the front and rear of the tie-rod clamps, seated on the axle body and to the pole socket at the front and the pintle bearing at the rear of the middle rail. The tie-rods are assembled under tension and rigidly brace the pole and pintle seats.

The doubletree and singletrees are formed of flange steel. The hole in the former for the doubletree bolt is bushed with a bronze nipple held in place by a steel nut, and may be replaced when worn. Two doubletree rods reach from the ends of the doubletree to the tie-rod clamps on the axle to which they are pinned. The neck yoke is now made of steel with steel sleeves and rings.

The pole is now made of steel and is prevented from turning in its seat by a pole pin. To the front end of the pole is riveted a pole plug and a neck-yoke stop. Just forward of the neck-yoke stop is the neck-yoke counterstop, which, with its spring, is hinged to the pole body and works through a slot cut in the underside of the pole.

A folding pole prop of flange steel is furnished with each limber and when not in use is carried in fastenings on the chest in the rear of the blanket holder.

A name plate is attached to the middle rail of each limber near the pintle seat, giving number, name of carriage, model, name of manufacturer, year of completion, and initials of inspector. *In all reports and correspondence the limber should be designated by the number, name, etc., as given thereon.* As repairs to implement attachments and other parts of limbers may from time to time be required, the parts needed should be referred to by the names given on the drawings or in the nomenclature of parts herein.

Brackets, with necessary leather straps, are provided for carrying a lantern, an ax, and picket rope on the chest front, a short-handled shovel underneath at the front, a pickax on the foot rest, a hatchet on the left side of the chest, shot tongs on the right door, and a paulin on the blanket holder. Three grip straps are provided for the connoneers in the front, at the top of the chest.

THE 3.8-INCH HOWITZER CAISSON, MODEL OF 1915.

[Plate XI.]

WEIGHTS, DIMENSIONS, ETC.

Weight, empty, without implements and ammunition.....	pounds..	1, 175. 0
Weight of tools, equipment, and spare pole body.....	do....	102. 5
Weight of ammunition carried.....	do....	819. 0
Weight, complete, equipped and loaded.....	do....	2, 096. 5
Rounds of ammunition carried.....	number..	24
Diameter of wheels.....	inches..	56
Width of track.....	do....	60
Turning angle.....	degrees..	74
Distance from center of limber axle to center of caisson axle when limbered (wheel base).....	inches..	117. 5

NOMENCLATURE OF PARTS.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
2	Wheels.....	Same as on carriage.....	IV	3
2	Wheel fastenings.....	do.....		
1	Axle.....			
1	Ammunition chest, complete, consisting of—			
1	Ammunition-chest plate, bottom.....	Forms bottom of chest.....		
1	Ammunition-chest plate, top.....	Forms top of chest.....		
1	Ax-handle support.....	Riveted to front plate.....		

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Ammunition chest, complete, consisting of—Continued.			
1	Ax-head pocket.....	Riveted to front plate.....		
1	Bucket-holder lid.....	Seat, of armor plate.....		
1	Bucket-holder rear plate.....	Riveted to top plate.....		
1	Bucket-holder transom, inner (right).....	On top of chest.....		
1	Bucket-holder transom, inner (left).....	do.....		
1	Bucket-holder transom, outer (right).....	do.....		
1	Bucket-holder transom, outer (left).....	do.....		
1	Chest frame.....	Angle inside front of chest.....		
2	Chest gussets.....	Brace front plate over side rails.....		
1	Diaphragm brace, right.....	Between front and rear diaphragms.....		
1	Diaphragm brace, left.....	do.....		
1	Door hinge, female, right (with lug).....	Riveted to sides of chest body.....		
1	Door hinge, female, right (without lug).....	do.....		
1	Door hinge, female, left (with lug).....	do.....		
1	Door hinge, female, left (without lug).....	do.....		
4	Door hinges, male.....	Riveted to bucket-holder lid.....		
4	Door hinges, female.....	Riveted to chest front plate.....		
4	0.37 x 4.5 pins.....	Hinge pins of bucket holder.....		
2	Door-prop rivets.....	Riveted to lid prop (guide end).....		
1	Front diaphragm.....	In chest.....		
1	Front plate.....	Armor plate front of chest.....		
2	Handrails.....	Riveted to lugs of hinges and handrail brackets.....		
1	Handrail bracket (right).....	Riveted to right side of chest.....		
1	Handrail bracket (left).....	Riveted to left side of chest.....		
2	Latch-pin plate (upper).....	Under top plate and on bottom plate.....		
2	Lid props.....	Assembled in lid-prop brackets and guides.....		
1	Lid-prop brackets (right).....	Riveted to bucket-holder lid.....		
1	Lid-prop bracket (left).....	do.....		
1	Lid-prop guide (right).....	On right side of chest.....		
1	Lid-prop guide (left).....	On left side of chest.....		
2	Lid-prop pins.....	Secure lid props to brackets.....		
1	Pick-mattock blade guard.....	On left side of chest.....		
24	Projectile tubes.....	Connect front and rear diaphragms.....		
24	Reinforce piece, long.....	On projectile tube.....		
24	Reinforce piece, short.....	do.....		
1	Rear diaphragm.....	In chest.....		
1	Shot bolt, right.....	In shot-bolt brackets.....		
1	Shot bolt, left.....	do.....		
1	Shot-bolt bracket (right).....	On bucket-holder rear plate.....		
1	Shot-bolt bracket (left).....	do.....		
2	Shot-bolt stops.....	Assembled with brackets.....		
2	Shot-bolt fastenings.....	Riveted to bucket-holder lid.....		
1	Spanner holder.....	Riveted to front plate.....		
1	Wrench holder.....	On front plate.....		
2	Ammunition chest doors, complete, consisting of—			
12	Cartridge case tubes (right).....	Connect door diaphragms.....		
12	Cartridge-case tubes (left).....	do.....		
24	Reinforce pieces, long.....	On cartridge-case tubes.....		
12	Reinforce pieces, short.....	do.....		
1	Door-bearing plate.....	Riveted to right-door diaphragm, front.....		
1	Door-diaphragm, front (right).....	In door.....		
1	Door diaphragm, front (left).....	do.....		
1	Door diaphragm, rear (right).....	do.....		
1	Door diaphragm, rear (left).....	do.....		
2	Door handles.....	On doorplates.....		
8	Door-handle reinforcements.....	Washers under door-handle rivets, inside.....		
2	Door hinges, male (right).....	Riveted to door frames and end plates.....		
2	Door hinges, male (left).....	do.....		
4	Door-hinge pins.....	In hinges.....		
2	Door end plates.....	On ends of doors.....		
1	Doorplate, right.....	Rear plate of door.....		
1	Doorplate, left.....	do.....		
1	Dust shield.....	On top of right door.....		
1	Fastening eye.....	On doorplate, left.....		
1	Lock bar.....	In bearings on left door.....		
1	Padlock, bolt snap, chain, 2 chain rings, and chain rivet.....	Attached to lock bar by chain.....		
1	Lock-bar bearing, right.....	Riveted one left door.....		

IV

3

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Ammunition chest, complete, consisting of—Continued.			
	Ammunition-chest doors, complete, consisting of—Continued.			
1	Lock-bar bearing, left.....	Riveted on left door.....		
4	0.125 x 0.796 ($\frac{3}{16}$) inch pins.....	In studs.....		
2	Lock-bar bearing caps.....	On bearings.....		
4	Lock-bar bearing studs.....	Secure lock-bar bearing caps.....		
2	Lock-bar pivots.....	In lock-bar bearings.....		
2	Lock links.....	Assembled in left door.....		
3	Projectile stops, long (right)....	Riveted to door diaphragm, front.....		
3	Projectile stops, long (left).....	.....do.....		
1	Projectile stop, medium (right)....	.....do.....		
1	Projectile stop, medium (left)....	.....do.....		
1	Projectile stop, short (right)....	.....do.....		
1	Projectile stop, short (left).....	.....do.....		
1	Shot-tongs handle fastening.....	On right door.....		
1	Shot-tongs pocket.....	.....do.....		
1	Shot-tongs stop.....	.....do.....		
1	Wing nut.....	Secures lock bar to doorplate (right)....		
1	Wing-nut pin and washer.....	On right door.....		
2	Wrench holders.....	On left door.....		
	Apron complete, consisting of—			
1	Apron.....	In hinges under ammunition chest.....		
2	Apron-latch staples.....	Riveted to apron.....		
1	Center hinge (right).....	.....do.....		
1	Center hinge (left).....	.....do.....		
2	Center-hinge pins.....	In center hinges.....		
1	End hinge (right).....	Riveted to apron.....		
1	End hinge (left).....	.....do.....		
2	End-hinge pins.....	In end hinges.....		
	Apron latches, complete, consisting of—			
2	Apron-latch washers.....	On latch base pins.....		
2	Handle pins.....	Secure latch handles to bodies.....		
2	0.368 x 1.55 pins.....	Secure latch bodies.....		
2	Latch bodies.....			
2	Latch handles.....	Pinned to latch bodies.....		
2	Latch plungers.....	In latch bodies.....		
2	Latch springs.....	Around plungers.....		
2	Brake beams.....	Hinged in brake-beam brackets.....		
2	Brake-beam guides.....	Riveted to front channel.....		
2	Brake-beam pins.....	Secure brake beams in brake brackets.....		
1	Brake bracket (right).....	Riveted to front channel and side rail.....		
1	Brake bracket (left).....	.....do.....		
2	Flange steel plates.....	Fillers between brackets and channel.....		
2	Brake cranks.....	Keyed to brake shaft.....		
1	Brake lever.....	On end of brake shaft.....		
1	Brake-lever catch.....	Riveted to brake lever.....		
2	Brake rods, complete, consisting of—			
2	Brake covers.....	Over brake-rod springs.....		
2	Brake rods.....	Screwed into brake-rod ends.....		
2	Brake-rod ends.....	Pinned to brake beams.....		
2	Brake-rod springs.....	On brake rods.....		
2	Brake-spring cover ends.....	Pinned to brake cranks.....		
2	Brake-spring cover heads.....	On brake rods, screwed into brake covers..		
4	Brake-rod pins.....	Secure brake rods to cranks and brake beams.....		
1	Brake segment.....	Riveted to brake segment bracket.....		
1	Brake-segment bracket.....	Clamped on axle.....		
1	Brake-segment bracket bolt.....	In bracket.....		
1	Brake-segment bracket bushing.....	In brake-segment bracket.....		
1	Brake-segment guard.....	Bolted to brake segment.....		
1	Brake shaft.....	In brake-shaft bearings.....		
2	Brake-shaft bearings.....	Riveted to axle.....		
2	Brake-shaft bearing bushings.....	In brake-shaft bearings.....		
2	Brake shoes.....	On brake beams.....		
4	Brake-shoe tap bolts.....	Secure shoes to brake beams.....		
1	Chain hook.....	Inside of left side rail.....		
2	Chest shims.....	Between side rails and chest bottom plate.....		
1	Frame handle (right).....	On either side of lunette bracket.....		
1	Frame handle (left).....	.....do.....		
1	Frame reinforce plate.....	Near front ends of side rails.....		
1	Front channel.....	Riveted to side rails.....		
1	Foot rest.....	In front of chest.....		
1	Foot-rest stiffener.....	Braces foot rest to front channel.....		
1	Foot-rest support.....	Riveted to foot rest and middle rails.....		
1	Latch base (right).....	For apron latch on side rail.....		
1	Latch base (left).....	.....do.....		
1	Lunette.....	In lunette bracket.....		

IV

3

NOMENCLATURE OF PARTS—Continued.

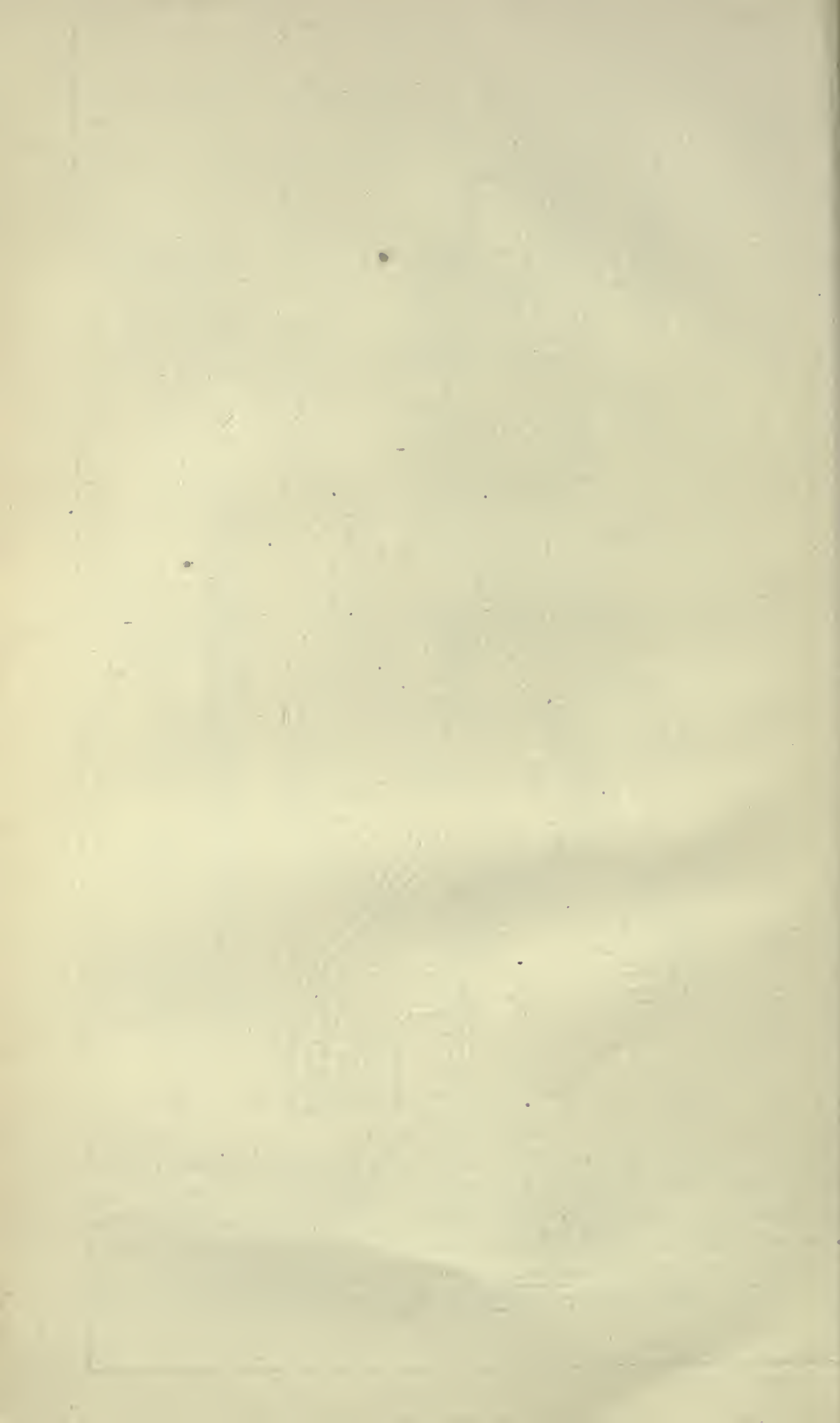
No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
1	Lunette nut.....	On lunette.....	IV	3
1	Lunette bracket.....	At front ends of side rails.....		
1	Middle rail.....	Under axle.....		
1	Name plate.....	Near rear end of side rail, left.....		
1	Pick-handle fastener.....	Riveted to foot rest.....		
1	Pick-head fastener.....	On foot rest.....		
1	Pick-mattock point guard.....	do.....		
1	Pintle, complete.....	Same as for limber.....		
1	Pintle bearing (in 2 sections).....	In rear ends of side rails.....		
2	Pintle-bearing bolts.....	Secure pintle bearing.....		
1	Prop, complete, consisting of—			
1	Fastening pin.....			
1	Washer nut.....	On pin.....		
2	Prop-chain clamps.....	Pinned to prop tubes.....		
1	Prop eye (right).....	At upper end of prop tube.....		
1	Prop eye (left).....	do.....		
1	Prop foot.....	On prop tubes.....		
2	Prop tubes.....	Connect prop eyes and foot.....		
1	Prop chain.....	On prop-chain clamps.....		
2	Prop-chain guides.....	Riveted to shovel support.....		
1	Segment rack.....	Riveted to brake segment.....		
2	Separators.....	Between brake segment and guard.....		
2	0.5 x 2 bolts.....	Through separators.....		
1	Shovel support.....	Between side rails opposite wheel guards.....		
1	Side rail (right).....	Forms frame of vehicle.....		
1	Side rail (left).....	do.....		
1	Spare-pole bracket.....	Riveted to middle rail under axle.....		
1	Spare-pole fastening.....	Assembled on fastening pin of prop.....		
1	Fastening nut.....	do.....		
1	Fastening washer.....	do.....		
1	Strap fasteners.....	Riveted to vehicle.....		
1	Ax.....	do.....		
3	Grip.....	do.....		
2	Pick mattock.....	do.....		
1	Shot tongs.....	do.....		
2	Shovel handle.....	do.....		
1	Spanner.....	do.....		
1	Wrench.....	do.....		
2	Wheel guards.....	On side rails.....		
<i>Crown nuts (standard).</i>				
8	0.375-inch.....			
1	0.525-inch.....			
1	0.625-inch.....			
4	0.75-inch.....			
1	1-inch.....			
• <i>Split pins.</i>				
6	0.125 x 0.75-inch.....			
4	0.125 x 0.8-inch.....			
3	0.125 x 1-inch.....			
2	0.125 x 1.75-inch.....			
5	0.156 ($\frac{1}{8}$) x 1-inch.....			
1	0.206 ($2\frac{1}{4}$) x 2-inch.....			
2	0.312 ($\frac{1}{4}$) x 1.625-inch.....			

DESCRIPTION OF THE CAISSON.

[Plate XI.]

The caisson is built up of metal throughout excepting the spokes and felloes of the wheels. The principal parts are the wheels, axle, ammunition chest, frame, pintle, foot rest, prop, apron, and brake.

The wheels and wheel fastenings are the same as and interchangeable with those on the limber and carriage. The axle is hollow, square in section, and is made from a single piece of forged steel.



The ammunition chest is built up of flange steel, having a top plate and bottom plate, joined at the sides of the chest. The chest front, made of armor plate, is riveted to the vertical flanges of the chest frame and extends up to form the front of the bucket holder. This frame is a steel angle formed into a rectangle and is riveted through its flanges to the top and bottom plates of the chest.

Two gussets over the side rails brace the front plate to the bottom plate. The bottom plate is reinforced at the points of riveting to the side rails of the frame at the front by means of the flanges on these gussets and at the rear by means of the flanges on the two diaphragm braces, which connect front and rear diaphragms.

Inside the chest are located two vertical diaphragms flanged all around and riveted to the chest. They are perforated with 24 holes, designed for projectiles.

Corresponding holes in the front and rear diaphragms are connected by brass projectile pockets to guide the projectiles in and stiffen the diaphragms. The perforations in the rear diaphragm are made conical, and, after the projectile pockets are seated, these cones fit the taper of the rotating bands of the projectiles, forming stops for the same.

Each tube or pocket in the caisson chest has its ends crimped over the flanges of the perforations and has beads expanding against both diaphragms, thereby securing it in position.

A bucket holder or seat is riveted to the chest top and supported by four transoms and a rear plate forming three compartments. The bucket-holder lid is of 0.15 armor plate, hinged in four places, being held in an open position by lid props on each side which slide in slots of the lid-prop guides riveted to the sides of the chest and to the outer transoms of the bucket holder. The slots of the lid-prop guides are enlarged at the ends to allow the sliding ends of the prop to drop in and hold the lid open. Shot bolts in brackets riveted to the bucket-holder rear plate engage in fasteners on the lid to secure the same in the closed position.

The handrail brackets riveted to the top plate of the chest support handrails at either side of the vehicle.

The chest doors are similar to those on the limber chest in construction and operation with the exception that the flange-steel frame has inserted in its end a door end plate of 0.15-inch armor plate.

The frame consists of two side rails, a middle rail, and a front channel. The side rails are of flange-steel channel section with their flanges turned inward. They are parallel under the chest and forward to the front channel, to which they are riveted. The front ends of the rails converge and are riveted together and to the frame

reinforce plate and also to the lunette bracket. The lunette is bolted in its seat on the lunette bracket. Two frame handles are riveted to the side rails at the lunette bracket. The rear ends of the rails also converge and are riveted together and to the middle rail, forming a seat for the pintle bearing, in which the pintle is assembled. The pintle is identical with that used on the limber. The middle rail of channel section extends under and to the front of the axle from the pintle bearing and is divided into two angles, which are riveted to side rails at their junction with the front channel. The front channel stiffens the frame at a point opposite the tires of the wheels. Brake brackets form extensions of the front channel outside of the side rails and are seats for the brake beams. Interposed between the side rails and the chest are chest shims which serve to increase the bearing of the chest on the frame. The foot rest is a perforated flange-steel plate riveted to the web of the front channel and to the side rails. A stiffener and a support of flanged steel extend down the middle and along the rear end of the foot rest, respectively. The rear end of the stiffener is riveted to the support and the ends of the support to the middle rails.

The prop, formed of steel tubes connected at the lower end by a bronze foot, is hinged on the fastening pin which passes through the lunette bracket and side rails. When not in use the prop is swung up and held by the prop chain, leading from the prop legs, through guide holes in the shovel support and engaging a chain hook riveted in the left side rail.

An apron of armor plate 0.15 inch thick is hinged from the bottom of the axle. Two end hinges and two center hinges are riveted to the top edge of apron and engage lugs formed on the axle. The apron extends to within a short distance of the ground, the armor plate of this, the bucket holder lid, the chest front and the door end plates being needed for the protection of the ammunition servers in the rear from small-arms and shrapnel fire. To clear obstructions in traveling, the apron is made to swing to the rear, in which position it is held by apron latches attached to apron-latch bases, riveted to the side rails.

The brake beams of forged steel are pivoted in the brake brackets at the ends of the front channel and pass under the side rails. Cast-iron brake shoes are bolted to the beams and bear against the wheel tires when operated. The inner ends of the brake beams are supported by brake-beam guides riveted to the front channel and secured by the brake-rod pins and brake-rod ends to the brake rods. The front end of the brake rod is screwed into the brake-rod end, while the brake-rod spring slips over the rear end of the rod and abuts against a shoulder upon it.

The spring is covered by a tubular brake cover inclosed at each end by bronze pieces, called the spring-cover head and the spring-cover end. The spring is compressed between the spring cover and the shoulder on the brake rod, while the rod is arranged to have a short longitudinal movement against the pressure of the spring. The spring-cover end is pinned to a crank on the brake shaft. The shaft rotates in two brake shaft bearings pinned to lugs on the axle and in a brake segment bracket bolted about the right end of the axle. The brake segment, with the segment rack riveted thereto, is attached to this bracket. On a square on the right end of the shaft is pinned the brake lever which engages the segment rack. The brake guard is bolted to the brake segment and limits the lateral movement of the lever and furnishes a stop for the released position of the lever. The action of the brake is similar to that on the carriage.

The shovel support is riveted to the side rails, and strengthens the frame at the point of contact with the wheels in turning. Cast-iron wheel guards are provided to protect the frame at this point. The shovel is supported at its rear end by means of a flanged hole in the front channel through which the handle projects.

Three grip straps and attachments for carrying an ax and a spanner on the chest front and a pick mattock on the foot rest are provided, while on the top of the left door are fasteners for a wrench. On the right door are attachments for the shot tongs. Straps for a paulin are provided on the bucket holder lid.

A name plate is riveted on the left side rail on the rear and gives the number, name of carriage, model, name of manufacturer, year of completion, and initials of inspector.

In all reports and correspondence the caisson should be designated by the number, name, model, etc., given on this name plate. In all requests for spare parts for repairs, etc., the parts should be asked for by the names given on the plates or in the paragraph giving nomenclature of parts in this handbook.

3-INCH GUN AND 3.8-INCH HOWITZER, FORGE LIMBER, MODEL OF 1902.

WEIGHTS, DIMENSIONS, ETC.

Weight, empty, without equipment.....	pounds..	958
Weight, complete, equipped and loaded.....	do....	1, 577
Weight of forge limber and battery wagon, both complete, equipped and loaded.....	pounds..	4, 324
Diameter of wheels.....	inches..	56
Width of track.....	do....	60
Free height under limber.....	do....	26. 5
Turning angle with battery wagon.....	degrees..	75

NOMENCLATURE OF PARTS.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
2	Wheels and wheel fastenings.....	Same as on carriage.....	IV	9
1	Axle.....	.....	
1	Middle rail (upper and lower half).....	Riveted to axle.....		
	Consisting of—	.....	
1	Pole clamp.....	Riveted to middle rail.....		
1	Pole-prop bracket.....	Riveted to pole clamp and middle rail with limber prop in place.		
1	Pole-clamp bolt.....	In pole clamp.....		
1	Pole-clamp nut.....	.....	
1	Pole pin.....	Secures pole in seat.....		
1	Pole-pin reinforce.....	Riveted to lower half of middle rail.....		
1	Pole stop.....	Riveted between upper and lower half of middle rail.....		
2	Separating pieces.....	Riveted to middle rail with side rails.....		
1	Doubletree strap.....	Riveted to middle rail.....		
1	Doubletree bolt.....	In bolt clamp and doubletree strap.....		
1	Doubletree nut.....	.....	
1	Side rail (right).....	Riveted to axle and middle rail.....		
	Consisting of—	.....	
1	Reinforce plate, front.....	Riveted to side rail.....		
4	Reinforce plates, rear.....	do.....		
4	Sleeves.....	do.....		
1	Step.....	do.....		
1	Pole-prop pocket.....	do.....		
1	Side rail (left).....	Riveted to axle and middle rail.....		
	Consisting of—	.....	
1	Reinforce plate, front.....	Riveted to side rail.....		
4	Reinforce plates, rear.....	do.....		
4	Sleeves.....	do.....		
1	Step.....	do.....		
1	Pole-prop support.....	do.....		
1	Name plate.....	Riveted to middle rail.....		
1	Limber prop.....	Assembled to middle rail by means of pole-clamp eye.		
	Consisting of—	.....	
1	Limber-prop foot.....	Pinned to bottom of prop.....		
1	Limber-prop eye.....	Pinned to top of prop.....		
1	Chain.....	Secured to prop foot.....		
1	Chain handle.....	On chain.....		
1	Prop tube.....	Hinged to pole by prop eye.....		
1	Prop-chain fastening.....	Riveted to chain.....		
1	Prop-chain eye.....	Riveted to prop tube.....		
1	Tie-rod, rear (right).....	Brace middle rail from axle.....		
1	Tie-rod, rear (left).....	do.....		
2	Tie-rods, front.....	do.....		
1	Tie-rod clamp (right).....	On axle arms.....		
1	Tie-rod clamp (left).....	do.....		
6	Tie-rod pins.....	Fasten ends of tie-rods.....		
2	Doubletree rods.....	From doubletree to axle.....		
2	Doubletree rod pins.....	Secure rods to tie-rod clamps.....		
1	Foot rest:	.....	
	Consisting of—	.....	
1	Angle piece (right).....	Riveted to foot rest.....		
1	Angle piece (left).....	do.....		
2	Foot-rest liners.....	do.....		
1	Pick-handle rest, large end.....	do.....		
1	Pick-handle rest, small end.....	do.....		
1	Pick pocket, needle end.....	do.....		
1	Prop-chain button.....	do.....		
1	Prop-chain rivet.....	do.....		
1	Ax-handle bracket.....	do.....		
1	Pintle with bearing, complete, consisting of—	.....	
1	Pintle.....	Seated in pintle bearing.....		
1	Pintle latch.....	On pintle.....		
1	Pintle-latch pin.....	Forms pivot of latch.....		
1	Pintle-latch string.....	On pintle.....		
1	Pintle bearing (in two parts).....	Rear end of middle rail.....		
1	Pintle spring.....	In pintle bearing.....		
1	Pintle-spring pin.....	do.....		
2	Pintle-bearing bolts.....	Secures bearing to middle rail.....		
1	Doubletree.....	On doubletree bolt.....		
	Consisting of—	.....	
1	Doubletree body with reinforce.....	.....	
10	Separators.....	.....	
1	Nipple separator.....	Riveted together.....		
1	Doubletree hook (right).....	.....	
1	Doubletree hook (left).....	.....	

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Doubletree, consisting of—Continued.			
1	Doubletree nipple.....	Renewable.....		
1	Nipple nut.....			
1	Pole, complete, consisting of—			
1	Pole body.....			
1	Pole plug.....	Riveted in body.....		
1	Neck-yoke counter stop spring.....	Bears on neck-yoke counter stop.....		
1	Neck-yoke counter stop pin.....	Riveted in body.....		
1	Neck-yoke counter stop.....	Hinges on counter stop pin.....		
1	Neck-yoke stop.....	Riveted to body.....		
1	Neck-yoke chafing plate.....	Riveted to upper side of body.....		
1	Neck-yoke stop separator.....	Inside of body.....		
1	Neck-yoke stop rivet separator.....	do.....		
1	Pole-pin bushing.....	do.....		
1	Butt reinforce.....	Riveted to inside of body.....		
1	Forge limber chest, complete, consisting of—			
1	Back and left end.....	Part of body.....		
1	Front and right end.....	do.....		
1	Bottom.....	do.....		
1	Lid.....	Hinged to body.....		
1	Lid stiffener.....	On lid.....		
4	Chest-rail filler pieces.....	Riveted to body and chest rail.....		
1	Outer left-hand partition.....	Part of body.....		
1	Inner left-hand partition.....	do.....		
1	Inner right-hand partition.....	do.....		
1	Outer right-hand partition.....	do.....		
1	Longitudinal partition (right).....	do.....		
1	Longitudinal partition (left).....	do.....		
1	Left rear corner angle.....	do.....		
1	Right front corner angle.....	do.....		
2	Bottom stiffening angles.....	do.....		
2	Corner-tie pieces.....	do.....		
2	Filler pieces.....	Part of body under hand-rail brackets.....		
2	Shot-bolt stops.....	Riveted to body.....		
1	Shot-bolt bracket (right).....	do.....		
1	Shot-bolt bracket (left).....	do.....		
2	Shot-bolt filler pieces.....	do.....		
1	Hasp.....	do.....		
1	Hasp hinge.....	Riveted to lid.....		
1	Hasp-hinge pin.....	In hinge.....		
1	Padlock-chain rivet.....	Riveted to body.....		
1	Chest rail (right).....	do.....		
1	Chest rail (left).....	do.....		
4	Chest-rail connections.....	Riveted to chest.....		
4	Pins.....	Join chest to side rails.....		
1	Shot bolt (right).....	In brackets on chest body.....		
1	Shot bolt (left).....	do.....		
1	Shot-bolt hasp (right).....	Riveted to lid.....		
1	Shot-bolt hasp (left).....	do.....		
1	Wing-nut pin.....	Riveted to chest body.....		
1	Wing nut.....	Riveted on pin.....		
1	Wing-nut pin washer.....	On pin.....		
1	Wing-nut pin washer, large.....	Between pin and chest body.....		
1	Padlock, with chain and bolt snap.....	Eye rivet on chest body.....		
4	Hinges, male.....	Riveted to chest.....		
4	Hinges, female.....	do.....		
4	I lid-hinge pins.....			
4	Hand-rail brackets.....	Riveted to body of chest.....		
2	Hand-rail tubes.....	Connect hand-rail brackets.....		
1	Bucket holder.....	Riveted to top of chest.....		
1	I id-prop bracket.....	Riveted to lid.....		
1	I id-prop guide (left).....	Riveted to chest partition.....		
1	I id prop.....	Riveted on lid-prop bracket.....		
1	I id-prop rivet.....	Rivets lid prop to bracket.....		
1	I id-prop sliding rivet.....	Riveted on lid prop.....		
1	Ratchet-drill fastening, No. 1.....	Riveted to outer right-hand partition.....		
1	Ratchet-drill fastening, No. 2.....	Riveted to inside of chest back.....		
1	Forge-legs fastening, No. 1.....	Riveted to inner right-hand partition.....		
1	Forge-legs fastening, No. 2.....	do.....		
1	Screw-wrench fastening, No. 1.....	Riveted to outer right-hand partition.....		
1	Screw-wrench fastening, No. 2.....	do.....		
1	Chisel (cold iron) fastening.....	Riveted to inside of right end.....		
1	Chisel (hot iron) fastening.....	do.....		
1	Flatter fastening.....	do.....		
1	Hand-hammer fastening.....	Riveted to outer right-hand partition.....		
2	Fore punch and creaser fastenings.....	Riveted to inside of left end.....		
1	Shoeing-rasp fastening, No. 1.....	Riveted to inner right-hand partition.....		

IV

9

¹ The components are for the steel pole, which will be issued to replace the wooden pole when the latter becomes unserviceable and the present supply of wooden poles is exhausted.

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
	Forge limber chest, complete, consisting of—Continued.			
1	Shoeing-rasp fastening, No. 2.....	Riveted to inner right-hand partition.....		
1	Flat bastard file fastening.....	Riveted to inner left-hand partition.....		
1	Taps and dies fastening, No. 1.....	Riveted to inside of back of chest near left end.		
1	Taps and dies fastening, No. 2.....	Riveted to inside of front of chest near left end.		
1	Square fastening, No. 1.....	Riveted to underside of lid near center, front.		
1	Square fastening, No. 2.....	Riveted to underside of lid near center, rear.		
1	Square fastening, No. 3.....	Riveted to underside of lid near right end, rear.		
1	Riveting hammer fastening.....	Riveted to outer right-hand partition.....		
1	Shoeing hammer fastening.....	do.....		
1	Clinching iron fastening.....	do.....		
1	Hardie fastening.....	Riveted to inside of right end.....		
1	Oiler fastening.....	Screwed to anvil block.....		
3	Portable forge fastenings.....	Riveted to underside of lid.....		
1	Forge gear wheel fastening, No. 1..	Riveted to inner left-hand partition.....		
1	Forge gear wheel fastening, No. 2..	Riveted to lid prop bracket and lid.....		
2	Anvil fastenings.....	Riveted to lid.....		
1	Sledge handle bracket.....	Riveted to bottom of chest.....		
1	Sledge holder.....	Riveted to foot rest.....		
1	Ax-head bracket.....	Riveted to bottom of chest.....		
2	Front oil-can supports.....	do.....		
2	Middle oil-can supports.....	do.....		
2	Rear oil-can supports.....	do.....		
2	Oil-can covers.....	Hinged to rear oil-can supports.....		
2	Oil-can support latches.....	On covers.....		
2	Latch pins.....	On latches.....		
2	Oil-can support latch springs.....	In chest.....		
1	Wooden packing for forge.....	do.....		
1	Wooden packing for anvil.....	do.....		
1	Wooden packing for small tools.....	do.....		
1	Wooden packing for rivet sets.....	do.....		
2	Wooden linings for horseshoe compartment, bottom.....	do.....		
4	Wooden linings for horseshoe compartment, side.....	do.....		
4	Wooden linings for horseshoe compartment, end.....	do.....		
1	Packing strap, rivet set.....	On packing for rivet sets.....		
2	Oil-can support hinges.....	Riveted to rear oil-can supports.....		
2	Cover hinge pins.....	Connects hinge and cover.....		
1	Hatchet-blade bracket.....	Riveted to chest.....		
1	Hatchet-handle fastener.....	do.....		
1	Pick pocket, chisel end.....	do.....		
1	Ax-head bracket.....	do.....		
1	Shovel-blade bracket.....	do.....		
1	Lantern bracket, consisting of—			
1	Lantern-bracket body.....	do.....		
1	Lantern-bracket bottom.....	Riveted to body.....		
2	Lantern-strap fasteners.....	do.....		
1	Shovel-handle bracket.....	Riveted to foot rest and middle rail.....		
	<i>Strap fasteners.</i>			
1	Ax.....	Riveted to chest.....		
3	Grip.....	do.....		
1	Hatchet handle.....	do.....		
8	Limber blanket.....	do.....		
1	Paulin strap.....	do.....		
2	Pick head.....	Riveted to foot rest.....		
8	Picket rope.....	Riveted on chest.....		
1	Pole prop.....	Riveted to side rail.....		
1	Shovel handle.....	Riveted to foot rest.....		
2	Sledge strap.....	do.....		
	<i>Crown nuts.</i>			
1	0.625-inch.....	Doubletree bolt.....		
2	0.75-inch.....	Pintle bearing bolts.....		
	<i>Split pins.</i>			
9	0.156 ($\frac{1}{4}$) \times 1 inch.....			
4	0.25 \times 1.5 inch.....			

The forge-limber chest is a rectangular flange steel box with chest lid on top. The lid is flanged all around, fitting over the body of the chest to make it water-tight. It is secured in front to the body of the chest by four hinges, and in rear it is held in its closed position by a shot bolt at each corner and by a hasp and wing nut in the middle. The shot bolts are seated in brackets riveted to the chest, while the shot-bolt eyes are riveted to the lid; the hasp is hinged to a hasp-hinge plate riveted to the lid, and the wing nut is attached to the wing-nut pin, riveted to the body of the chest. A spring padlock, fastened by chain and staple to the chest, may be passed through the eye of the wing nut to lock the chest lid when closed. Outside on top is a raised seat, fastened to the chest lid, with spaces underneath for carrying three watering buckets. The seat has a handrail at each end riveted to the chest body. Various strap fasteners for paulin straps, grip straps, picket-rope straps, etc., and brackets for carrying all the implements carried on other limbers are provided.

Arrangements are also provided for carrying on each forge-limber chest one sledge and two oil cans. The sledge rests in a sledge holder riveted on the right end of the foot rest, with the handle projecting to the rear through a sledge-handle bracket riveted to the bottom of the chest. The oil cans are carried one under each end of the chest. For this purpose, for each can three flange steel brackets, called the front, middle, and rear oil-can supports, are riveted to the bottom of the chest. The can is placed in the supports from the rear, and is retained in place by a bronze cover on the rear bracket. This cover is hinged at the bottom and held in close position by a spring latch. If desired, the latch may be more firmly secured in locking position by a split pin.

Inside, the forge chest is divided into five compartments by four vertical partitions reaching from front to rear. The end compartments are comparatively narrow and are fitted with fastenings for carrying smith's and machinist's tools, each so that it can be taken out without removing any other. The compartments next to the tool compartments are wider and are subdivided by lateral partitions forming two compartments for horseshoes and two for horseshoe nails, with a total capacity for 300 pounds of horseshoes and 50 pounds of nails. The horseshoes are carried loose in the compartment, which is wood lined; the horseshoe nails may also be carried loose, though the nail compartments are made of the proper size to take the 25-pound box of nails as issued. All of the partitions in the chest are made of flange steel, flanged on three sides and riveted through the flanges to the chest. The middle compartment is fitted to take the field forge in front, the anvil in rear, and several small tools in brackets on the walls. The anvil is bedded in a wooden seat

on the bottom of the chest, and with the forge is held in place by cleats on the chest lid. The latter is held in its open position by a lid prop, which is hinged to a lid-prop bracket riveted to the under-side of the lid and having at its other end a button running in a lid-prop guide riveted to one of the chest partitions.

3.8-INCH HOWITZER BATTERY WAGON, MODEL OF 1902.

WEIGHTS, DIMENSIONS, ETC.

Weight of battery wagon, empty.....	pounds..	1,244
Weight of battery wagon, completely equipped and loaded.....	do....	2,747
Weight of forge limber and battery wagon, both completely equipped and loaded.....	pounds..	4,324
Diameter of wheels.....	inches..	56
Width of track.....	do....	60
Free height under battery wagon.....	do....	26
Turning angle.....	degrees..	75

NOMENCLATURE OF PARTS.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
2	Wheels.....	Same as on carriage.....	IV	9
2	Wheel fastenings, complete.....	do.....		
1	Axle.....	Between axle and body.....		
1	Axle block, center.....	do.....		
1	Axle-block end (right).....	do.....		
1	Axle-block end (left).....	do.....		
1	Middle brace (right).....	Riveted to axle and rail.....		
1	Middle brace (left).....	do.....		
1	Side rail (right).....	Riveted to axle lugs.....		
1	Side rail (left).....	do.....		
1	Name plate.....	Riveted on left side rail.....		
1	Foot-rest.....	On foot-rest brackets.....		
2	Foot-rest brackets, outer (right and left).....	Bolted to front of body.....		
2	Foot-rest brackets, inner, with 4 bolts and nuts.....	do.....		
2	Foot-rest supports (right and left).....	Tie outer corner of foot rest to end stiffeners.....		
2	Foot-rest bracket fillers.....	Between foot-rest brackets, outer and body.....		
1	Brake channel.....	Fastened to side rails.....		
2	Channel support.....	do.....		
2	Outer channel support.....	do.....		
1	Box bottom (right).....	Riveted to ends of brake channel.....		
1	Box bottom (left).....	do.....		
2	Brake-box fillers.....	do.....		
1	Brake-beam guide (right).....	Riveted to brake channel.....		
1	Brake-beam guide (left).....	do.....		
1	Front brake brace (right).....	Braces channel to side rail.....		
1	Front brake brace (left).....	do.....		
1	Rear brake brace (right).....	do.....		
1	Rear brake brace (left).....	do.....		
1	Cross brace.....	Riveted to side rails.....		
1	Cover.....	Over top of body.....		
1	Frame reinforce plate.....	Front end of side rail.....		
1	Frame handle, right.....	do.....		
1	Lunette bracket.....	do.....		
2	Lunette bracket filler plate.....	Riveted to bracket.....		
1	Lunette.....	In lunette bracket.....		
1	Lunette nut.....	On lunette.....		
1	Prop, complete, consisting of—			
1	Fastening pin.....	On pin.....		
1	Washer nut.....	Pinned to prop tubes.....		
2	Prop chain clamps.....	At upper end of prop tube.....		
1	Prop eye, right.....	do.....		
1	Prop eye, left.....	do.....		
1	Prop foot.....	On prop tubes.....		
2	Prop tubes.....	Connect prop eyes and foot.....		
1	Prop-chain guide.....	Riveted to cross brace.....		

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
1	Prop-chain button.....	Riveted to lunette bracket.....	IV	9
1	Prop-head pin.....	Attaches prop to lunette bracket.....		
2	Brake beams.....	Hinged in brake box.....		
2	Brake shoes.....	On ends of brake beams.....		
4	Brake-shoe tap bolts.....	Connect shoe to beam.....		
2	Brake-beam pins.....			
3	Brake-rod ends.....			
2	Brake rods.....			
2	Brake-rod springs.....			
2	Brake-spring covers.....			
2	Brake-spring cover heads.....			
2	Brake-spring cover ends.....			
6	Brake-rod pins.....			
2	Brake cranks.....	On brake shaft.....		
2	Brake-crank bolts and nuts.....	Joins cranks to brake rods.....		
2	Brake-shaft bearings.....	On brake shaft.....		
2	Brake-shaft bushings.....	In bearings.....		
1	Brake-shaft bearing, right.....	Riveted to axle lug.....		
1	Brake shaft.....	In bearings on axle.....		
1	Brake-shaft crank.....	On right end of break shaft.....		
1	Brake lever.....	On pivot on wagon body.....		
1	Lever rod.....	Connects brake-shaft crank and brake lever.....		
4	Handrail brackets.....	Riveted to forward lid.....		
2	Handrails.....	On handrail brackets.....		
1	Brake-lever catch.....	On brake lever.....		
1	Brake-lever pivot.....	Riveted on wagon body.....		
1	Brake-lever pivot backing.....	do.....		
1	Brake-pivot washer.....	On pivot.....		
5	Brake bolts.....	Fasten pivot to side of chest.....		
1	Brake segment.....	Attached to wagon body.....		
1	Segment rack.....	Riveted to brake segment.....		
1	Brake-segment bolt and washer.....	Through brake segment, guard, upper separator, and body.....		
1	Brake guard.....	Attached to segment.....		
1	Brake-segment separator, upper.....	Between segment and guard.....		
1	Brake-segment separator, lower.....	do.....		
1	Oil-can front support.....	Riveted to side rails, rear of axle.....		
1	Oil-can middle support.....	do.....		
1	Oil-can rear support.....	do.....		
6	Oil-can support bolts.....	Tie supports to wagon body.....		
1	Oil-can bar.....	Hinged to left side rail.....		
1	Oil-can bar buffer.....	On oil-can bar.....		
1	Oil-can bar bracket.....	Riveted to left side rail.....		
1	Oil-can bar staple.....	In bracket.....		
3	Oil-can locking plates.....	On oil-can bar.....		
1	Oil-can bar catch.....	Riveted to right side rail.....		
1	Padlock, chain and bolt snap.....	For locking bar on catch.....		
1	Filler plate.....	Riveted to right side rail.....		
3	Oil-can slats, wooden.....	On oil-can supports.....		
2	Oil-can slats, wooden.....	do.....		
1	Oil-can slat, wooden.....	do.....		
1	Oil-can slat, wooden (left).....	do.....		
1	Wagon body, woodwork.....			
6	Washers, square.....	Under heads of oil-can support bolts.....		
1	Center tie rod.....	Horizontally through center of body.....		
1	Top tie rod.....	Horizontally across top of body.....		
1	Vertical tie rod, with 4 nuts and 2 washers.....	Vertically through center of body.....		
1	Side strap (right).....	Vertically on sides of body.....		
1	Side strap (left).....			
1	Corner iron, rear end (right).....	Rear corners of body, wagons Nos. 1 to 95, inclusive.		
1	Corner iron, rear end (left).....			
1	Corner iron, rear end (right).....	Rear corners of body, wagons after No. 95.		
1	Corner iron, rear end (left).....			
1	Corner iron (right).....	Front corners of body.....		
1	Corner iron (left).....	do.....		
4	Body fastening plates, with nuts.....	Fasten to side rails.....		
2	Lid stiffeners.....	Tee irons riveted to lids.....		
2	End stiffeners, with nuts and washers.....	Riveted to ends and extends through sides on new work; end tie-rods on repair work.		
1	Vertical tie-rod washer.....	V-shaped washer near lower end of rod.....		
1	Floor plate (spare breech mechanism chest).....	Screwed to upper floor.....		
3	Hinges for rear door.....	Hinge door to body.....		
8	Hinges, 12-inch, steel, strap.....	For lids.....		
2	Hasps.....	For securing lids.....		
9	Hasp rivets.....			
1	Hasp.....	For securing rear door.....		
3	Hasp staples.....	For securing lids and rear door.....		

NOMENCLATURE OF PARTS—Continued.

No.	Name of part.	Location, etc.	Property classification.	
			Class.	Section.
3	Hasp-staple plates.....	Screwed to chest.....	IV	9
3	Lock-chain staples.....	For attaching padlock.....		
3	Lock-chain staple plates.....	Riveted to chest.....		
2	Bolt snaps.....	For lids.....		
3	Padlocks, with clevises and rivets.....	For locking lids and rear door.....		
2	3-inch chains for padlocks.....	For lids.....		
1	5-inch chain for padlock.....	For rear door.....		
1	Shot bolt (right).....	At corners of rear door.....		
1	Shot bolt (left).....	do.....		
1	Shot-bolt bracket (right).....	Screwed to rear door.....		
1	Shot-bolt bracket (left).....	do.....		
2	Shot-bolt eyes.....	Screwed to wagon body.....		
2	Shot-bolt stops.....	Screwed to rear door.....		
2	Chains.....	For rear door.....		
1	Chain fastening door (right).....	Riveted to rear door.....		
1	Chain fastening for door (left).....	do.....		
1	Chain fastening for body (right).....	Attached to body.....		
1	Chain fastening for body (left).....	do.....		
1	Spare-pole fastening.....	In spare-pole support (front).....		
1	Fastening washer.....	On spare-pole fastening.....		
1	0.625 crown nut.....	do.....		
1	Spare-pole rest.....	Riveted to brake channel.....		
1	Spare-pole support (front).....	Riveted to front of frame.....		
1	Spare-pole support (rear).....	Riveted and bolted to axle.....		
1	Pin, type A 0.866 x 2.75.....	Pins support, rear and support cap together.....		
2	Spare-pole support bolts.....	Bolts support (rear) to axle.....		
1	Spare-pole support cap (rear).....	Pinned to support (rear).....		
1	Swing bolt.....	In support (rear).....		
1	0.625 crown nut.....	On swing bolt.....		
2	Spare-wheel supports.....	Bolted on top of body.....		
2	Spare-wheel support caps.....	On support.....		
2	Cap-hinge pins.....	For support.....		
8	Spare-wheel-support bolts, washers, and nuts.....	Secure supports to body.....		
2	Lock pins for spare-wheel supports.....	In spare-wheel supports.....		
4	Spare-wheel fastenings.....	Fastened to body.....		
	Consisting of.....			
4	Spare-wheel fastening staples.....	do.....		
4	Spare-wheel fastening hinges (male).....			
4	Spare-wheel fastening hinges (female).....			
4	Spare-wheel fastening hooks.....			
12	Spare-wheel fastening pins.....			
4	Thongs.....	For spare-wheel fastenings.....		
7	Reinforce plates.....	Under wheel-cleat fastenings.....		
1	Reinforce plate, right, lower rear.....	do.....		
8	Wheel-cleat fastenings.....	Secure cleats to side of body.....		
16	Wheel-cleat strap bolts.....	Bolt straps to body.....		
4	Wheel cleats, wooden.....	On sides of body.....		
2	Lid-prop plates (right).....	Screwed to inside of body.....		
2	Lid-prop plates (left).....	do.....		
4	Lid props.....	Hold top lids open.....		
4	Lid-prop lugs.....	Screwed to under side of lid.....		
4	Lid-prop lug screws.....	Secure prop to lug.....		
1	Grindstone upper packing.....	On under side of rear lid.....		
1	Grindstone lower packing.....	On upper floor of body.....		
1	Grindstone frame pedestal.....	On lower packing.....		
1	Grindstone leg bracket, right end.....	On rear end of body.....		
1	Grindstone leg bracket, left end.....	do.....		
1	Grindstone packing nut.....	On packing stud.....		
1	Packing stud.....	In lower packing.....		
1	Jack-screw base packing.....	On upper floor of body.....		
2	Jack-screw handle packings.....	do.....		
2	Strap fasteners.....	do.....		
2	Grip-strap fasteners.....	On body.....		
4	Paulin-strap fasteners.....	do.....		

DESCRIPTION OF THE 3.8-INCH HOWITZER BATTERY WAGON, MODEL OF 1902.

The principal parts of the battery wagon are the wheels, wheel fastenings, axle, frame, wagon body, and brake. The wheels and wheel fastenings are interchangeable with those of the carriage.

The axle is hollow, square, and finished from a single piece of forged steel.

The frame consists of two side rails riveted to the axle and converging at the front ends in a bracket for a lunette. In front of the wheels the side rails are connected by a brake channel which forms a support for the brake beams of the road brake. The middle braces are fastened to lugs near the center of the axle and to the side rails at the brake channel connection. The front ends of the side rails are riveted to each other, to the frame reinforce plate, and to a lunette bracket. To the latter a lunette, interchangeable with the one on the carriage, is assembled by a lunette nut. A strong cross brace is riveted to and strengthens the side rails at their point of contact with the limber wheels in making short turns. A frame handle is attached to the right side of the frame at the lunette bracket for use in limbering, the handle on the left side being omitted to permit the permanent attachment of a forge vise, which is securely fastened and remains in place in traveling. The frame prop is pivoted on a pin through the lunette bracket and is A-shaped to afford greater steadiness to the unlimbered frame when the vise is used. For traveling, the prop is drawn under the side rails by means of a chain attached to the prop crossbar and leading through a chain guide on the cross brace to a button on the lunette bracket.

The ends of the brake channel are braced front and rear to the side rails and on the lower side are formed boxes in which the brake beams are pivoted. The brake box bottoms project to the front and form steps for mounting the vehicle. The outer ends of the brake beams carry brake shoes attached by the brake-shoe tap bolts, while the inner ends are supported by brake-beam guides, riveted to the brake channel. The brake shaft is assembled in brake-shaft bearings, and the brake-shaft bearing, right, riveted to the front lugs of the axle and carries two brake cranks, which are connected to the inner ends of the brake beams by brake rods similar to those on the caisson. The brake-shaft crank is mounted on the right end of the brake shaft and is connected by the lever rod with the brake lever, which is mounted upon a brake-lever pivot firmly attached to the right side on a diagonal side brace, front, near the front end of the wagon body. Here also is fastened the brake segment, having a segment rack with ratchet teeth. The brake is set by raising the brake lever and engaging it in the segment rack. When released, the weight of the lever holds the brakes off. A sheet-metal brake guard upon the brake segment guides the brake lever in its motion.

The spare pole is carried under the frame by the spare pole supports, front and rear, and the spare pole rest. The large end of the pole is secured to the spare pole support, front, by the spare pole fastening, while the small end is held in position in the spare pole

support, rear, by the spare pole support cap, rear. The spare pole rest bears against the pole and keeps it from wear due to vibration.

The wagon body is of wood and is attached to the side rails of the frame by four bolts and nuts. The interior of the body is divided into four compartments, of which the largest is entered from either end on top, the openings being covered by hinged lids. The other three compartments are in the lower rear portion of the body, and are entered by a door at the rear end opening downward. Of the three compartments, the right one is for the saddler's chest, the left one for the carpenter's chest, and the middle one is for the cleaning materials and small-stores chest. The door to these compartments is held in closed position by a shot bolt at each corner and by a hasp hinged to the door at the center, secured over a staple riveted to the wagon body. The lids on top of the body are similarly secured by hasp and staple, and each is provided with a spring padlock attached by a chain to the body. The door in the rear has two door chains to hold it in a horizontal position when open; the lids on top are provided with lid props, one at each end of each lid. These lid props are hinged to lid-prop lugs fastened to the lid and having at their other ends buttons which work in guides fastened to the inner walls of the body. The sides of the body are framed and braced to the bottom, and are cross braced within by means of side straps, a vertical and a horizontal tie rod, and two transverse braces, to give sufficient strength for carrying two spare wheels. These are secured in an upright position, one at each side, over the axle. The inner end of the wheel hub rests in a bronze spare-wheel support on top of the wagon body, and the wheel is further secured by two spare-wheel fastenings attached to the sides.

Axle blocks are added between the chest bottom and the axle for additional support under the spare wheels. A perforated foot rest is bolted to the front end of the chest and supported by two foot-rest brackets, inner, two foot-rest brackets, outer, and tie rods at each end called foot-rest supports. Two handrail brackets with handrails are riveted on each end of the front lid and two grip straps are provided on the front of the chest. Two paulin straps are secured in fasteners to the front lid of the body. Two grip straps are secured in fasteners to the front of the wagon body.

The grindstone and frame, the jackscrew, and the packing chest containing the spare breech mechanism, are carried in suitable fastenings inside of the wagon body and over the compartments for saddler's and carpenter's chests.

In rear of the axle under the wagon body are carried three oil cans, each of a capacity of 5 gallons. For this purpose transverse metal straps are riveted to the side rails and support longitudinal wooden slats upon which the cans rest. The cans are made of heavy

sheet brass. Each is provided with a filling hole on top and with a special stopcock closed by a nozzle screw plug at the rear end. The stopcock is placed so that oil may be conveniently drawn from the can without removing the latter from the wagon. A steel bar with a wooden face bears against the rear end of the cans and holds them in place.

The carpenter's chest is an iron-bound wooden chest and contains a complete assortment of carpenter's tools, so arranged that each tool can be taken from its place in the box without removing any other. The saddler's chest is a combined tool chest and stitching horse. For the latter purpose the box forming the seat rests upon four hinged legs, cross braced to each other. The stitching clamp is secured in a socket on one end of the chest, while the door swinging open on the left side brings the tools into convenient reach of the saddler. For transportation the clamp is removed from its seat and placed within the chest, the legs are folded over against each end and held by the leg braces, permitting the chest to be carried in a small compartment. Both the carpenter's and the saddler's chests are provided with handles and locks.

The middle compartment at the rear of the wagon body takes a wooden chest with a hinged lid containing perishable material and various small stores for the artificer's use. Included in these items are sal soda, thread, wax, nails, buckles, screws, tacks, rivets, burrs, etc.

One chest for spare sights is issued to each battery and is transported in the battery or store wagon. This chest provides for the safe packing of one sight, complete; one panoramic sight; one range quadrant; one combined teat wrench and screw driver; one bore sight, breech, and one bore sight, muzzle, complete.

3-INCH GUN AND 3.8-INCH HOWITZER, STORE LIMBER, MODEL OF 1902.

WEIGHTS, DIMENSIONS, ETC.

Weight of store limber, empty.....	pounds..	955
Weight of store limber, completely equipped and loaded.....	do....	1, 106
Weight of store limber and store wagon, both completely equipped and loaded.....	pounds..	4, 008
Diameter of wheels.....	inches..	56
Width of track.....	do....	60
Free height under limber.....	do....	26. 5
Turning angle with store wagon.....	degrees..	75

The store limber, model of 1902 is substantially the same as the forge limber, model of 1902, except that the chest is fitted with compartments for carrying the following battery fire-control equipment:

10 battery commanders' rulers, wooden.¹

1 battery commander's telescope and mount in case.

¹ Metal B. C. rulers with cases may be retained.

- 1 battery commander's telescope tripod in case.
- 5 flash lights with hoods.
- 16 flash lights without hoods.
- 1 steel tape, 100 feet.
- 2 time-interval recorders with chains.

Fire-control equipment furnished by the Signal Corps.

The compartments for telephones, field glasses, battery commander's telescope, and battery case are padded to protect the contents from injury.

THE 3.8-INCH HOWITZER STORE WAGON, MODEL OF 1902.

WEIGHTS, DIMENSIONS, ETC.

Weight of store wagon, empty.....	pounds..	1, 190
Weight of store wagon, completely equipped and loaded.....	do....	2, 902
Diameter of wheels.....	inches..	56
Width of track.....	do....	60
Free height under store wagon.....	do....	26
Turning angle.....	degrees..	75

The store wagon, model of 1902, is the same as the battery wagon, model of 1902, with these exceptions: The vise is omitted, and a frame handle is attached in its place; the store-wagon body forms a single compartment, with two doors on top, the tool-box compartments of the battery-wagon body and the door opening into them being omitted. A crowbar support, front, takes the two left inside rivets for the cross brace, and a crowbar support, rear, is riveted to the chest bottom in front of the axle. A strap fastener with a strap on the left side rail secures the crowbar in the supports. Arrangements similar to those of the battery wagon are made for carrying two spare wheels and three oil cans. The store wagon is intended primarily for carrying such stores, spare parts, and materials as can not be carried in the battery wagon, and in addition, such stores as may be designated by proper authority.

The battery and store wagons, model of 1902, which are now in service are being modified as they are turned in to an arsenal for repair or alteration. The main modifications are the addition of a foot rest at the front of the chest, transferring the brake system from the rear to the front of the vehicle, and adding handrails, grip and paulin straps to the chest. Axle blocks are added to support the chest under the spare wheels.

3.8-INCH HOWITZER BATTERY AND STORE WAGONS, MODELS OF 1902M¹.

[Plate XII (battery wagon).]

WEIGHTS, DIMENSIONS, ETC.

Weight of battery wagon, empty.....	pounds..	1, 444
Weight of battery wagon, completely equipped and loaded.....	do....	2, 947
Weight of forge limber and battery wagon, both completely equipped and loaded.....	pounds..	4, 524

Weight of store wagon, empty.....	pounds..	1, 390
Weight of store wagon, completely equipped and loaded.....	do....	3, 102
Weight of store limber and store wagon, both completely equipped and loaded.....	pounds..	4, 208
Diameter of wheels.....	inches..	56
Width of track.....	do.....	60
Free height under wagons.....	do....	24. 5
Turning angle with limbers.....	degrees..	75
Weight (approximate) at lunette of both wagons, loaded.....	pounds..	112

NOMENCLATURE OF PARTS.

Number on store wagon.	Number on battery wagon.	Name of part.	Location, etc.	Property classification.	
				Class.	Section.
...	1	Arbor-bearing cover.....	In grinstone packing "A".....	IV	9
1	1	Axle.....			
2	2	Bearing plate (transverse brace).....	At upper ends of transverse braces.....		
1	1	Brake-beam guide, right.....	Riveted to brake channel.....		
1	1	Brake-beam guide, left.....	do.....		
2	2	Brake-beam pin.....			
2	2	Brake beam.....	Hinged in brake box.....		
8	8	Brake bolt.....	In brake-lever pivot backing.....		
8	8	Brake-bolt nuts.....	On bolts.....		
2	2	Brake-box filler.....	Riveted to end of brake channel.....		
1	1	Brake channel.....	Fastened to side rail.....		
2	2	Brake crank.....	On brake shaft.....		
1	1	Brake guard.....	Attached to segment.....		
1	1	Brake lever.....	On brake-lever pivot.....		
1	1	Brake-lever catch.....	On brake lever.....		
1	1	Brake-lever pivot.....	Riveted on wagon body.....		
1	1	Brake-lever pivot backing.....	do.....		
1	1	Brake-pivot lower filler.....	Between pivot and box body.....		
1	1	Brake-pivot side filler.....	do.....		
2	2	Brake rod.....	Connects brake beam and brake crank.....		
3	3	Brake-rod end.....	On end of brake rods and connecting rod.....		
6	6	Brake-rod pin.....			
2	2	Brake-rod spring.....	Inside of brake-spring cover.....		
1	1	Brake segment.....	Upper end bolted to box body.....		
1	1	Brake-segment brace.....	Supports lower end of brake segment.....		
1	1	Brake shaft.....	In bearings on axle.....		
2	2	Brake-shaft bearing.....	On brake shaft.....		
1	1	Brake-shaft bearing, right.....	do.....		
1	1	Brake-shaft crank.....	On right end of brake shaft.....		
2	2	Brake-shaft bushing.....	In brake-shaft bearing.....		
2	2	Brake-shaft bushing, right.....	In brake-shaft bearing, right.....		
2	2	Brake shoe.....	On outer end of brake beam.....		
4	4	Brake shoe tap bolts.....	Fasten brake shoe to beam.....		
2	2	Brake spring cover.....	Connects brake-spring cover head and end.....		
2	2	Brake-spring cover end.....	Screwed into brake-spring cover.....		
2	2	Brake-spring cover head.....	On brake rod and screwed into brake-spring cover.....		
1	1	Box bottom, left.....	Riveted to end of brake channel.....		
1	1	Box bottom, right.....	do.....		
...	1	Box front.....	Front of battery wagon body.....		
16	16	Cap screw, flat head.....	Attach spare-wheel fastenings.....		
16	16	Cap screw, hex. head.....	do.....		
...	2	Chain (door).....	In chain fastenings.....		
...	2	Chain fastenings (body), 1 right, 1 left.....	Bolted to corner irons, rear.....		
...	2	Chain fastening (door).....	Riveted to door.....		
...	2	Chain-fastening filler.....	Between door and fastening.....		
4	4	Channel support.....	Fastened to side rails.....		
1	1	Cleat, inner.....	On cover board, locate chests for spare breech mechanism.....		
1	1	Cleat, outer.....	do.....		
1	1	Connecting rod.....	Connects brake shaft crank and brake lever.....		
1	1	Connecting-rod end.....	On front end of connecting rod.....		
...	1	Corner iron, inner (rear), right.....	On box body.....		
...	1	Corner iron, inner (rear), left.....	do.....		
2	1	Corner iron, inner (front), right.....	do.....		
2	1	Corner iron, inner (front), left.....	do.....		
...	1	Corner iron, outer (rear), right.....	Bolted through box body to corner irons, inner.....		

NOMENCLATURE OF PARTS—Continued.

Number on store wagon.	Number on battery wagon.	Name of part.	Location, etc.	Property classification.	
				Class.	Section.
....	1	Corner iron, outer (rear), left.....	Bolted through box body to corner irons, inner.		
2	1	Corner iron, outer (front), right.....	do		
2	1	Corner iron, outer (front), left.....	do		
1	1	Cover.....	Over top of box body		
....	1	Cover board.....	Over partitions		
1	1	Cross brace.....	Riveted to side rails		
1	1	Cross rail, front.....	Under front of floor body		
2	2	Cross rail, intermediate.....	Under middle of floor body		
1	1	Cross rail, rear.....	Under rear of floor body		
1	....	Crow-bar support, rear.....	Riveted to floor (underneath)		
....	4	Door boards.....	In door body		
....	3	Door hinge plate.....	Attached to floor of battery wagon		
....	1	Door hinge strap, center.....	Riveted to door of battery wagon		
....	1	Door hinge, strap, outer, right.....	do		
....	1	Door hinge strap, outer, left.....	do		
4	2	End strap.....	On box front of battery wagon and front and tail boards of store wagon.		
1	1	Floor board, right.....	In floor body		
6	6	Floor board, intermediate.....	do		
1	1	Floor board, left.....	do		
....	1	Floor cleat, right.....	Screwed to floor		
....	1	Floor cleat, left.....	do		
....	1	Floor cleat, front, right.....	do		
....	1	Floor cleat, front, left.....	do		
....	1	Floor cleat, rear, right.....	do		
....	1	Floor cleat, rear, left.....	do		
....	3	Floor plate.....	1 in cover board at chest for spare breech mechanism; 2 in sideboards at packing chest for supplies.		
1	1	Filler block.....	Between brake guard and sideboard		
1	1	Filler plate.....	Riveted to right side rail at lock bar		
1	1	Foot rest.....	On brackets		
1	1	Foot-rest bracket, inner, right.....	Bolted to front of body		
1	1	Foot-rest bracket, inner, left.....	do		
1	1	Foot-rest bracket, outer, right.....	do		
1	1	Foot-rest bracket, outer, left.....	do		
1	1	Foot-rest support, right.....	Tie outer corner of foot rest to end stiffener.		
1	1	Foot-rest support, left.....	do		
1	1	Frame handle, right.....	On front end of side rail		
1	1	Frame handle, left.....	do		
1	1	Frame reinforce plate.....	do		
1	....	Front board.....	Front of store wagon body		
1	1	Front brake brace, right.....	Braces channel to side rail		
1	1	Front brake brace, left.....	do		
....	4	Grindstone-frame pedestal.....			
....	1	Grindstone-leg bracket, right end.....	Riveted to tailboard		
....	1	Grindstone-leg bracket, left end.....	do		
....	1	Grindstone lower packing.....	Screwed to cover board		
....	1	Grindstone packing "A".....	Bolted to forward lid		
....	1	Grindstone packing "B".....	do		
....	1	Grindstone packing "C".....	do		
....	1	Grindstone packing nut.....	On packing stud		
....	1	Grindstone packing stud.....	In lower packing		
4	4	Handrail bracket.....	On lid		
2	2	Handrail tube.....	On brackets		
....	1	Hasp plate (door).....	Riveted to door		
2	2	Hasp plate (lid).....	Riveted to lid		
2	3	Hasp.....	Assembled to hasp plates		
2	2	Hasp rail.....	In lid body		
2	3	Hasp staple.....	Riveted to staple plate		
2	3	Hasp-staple plate.....	Riveted to front and tail boards		
1	1	Hinge board, front.....	Top of box		
1	1	Hinge board, rear.....	do		
....	3	Hinge rivet (door).....	In hinge		
6	6	Hinge rivet (lid).....	Joins plate and strap		
8	8	Hinge rivet (spare wheel fastening bar).....	In hinge		
2	2	Hinge rivet (spare wheel support swing bolts).....	do		
2	2	Hinge rivet (spare wheel support stud).....	do		
....	1	Jackscrow-base packing.....	On cover board		
....	2	Jackscrow-handle packing.....	do		
10	10	Lid boards.....	In lid body		
6	6	Lid hinge plate.....	On top rail		
6	6	Lid hinge strap.....	On lid		
4	4	Lid prop.....	Hinged to lid		

NOMENCLATURE OF PARTS—Continued.

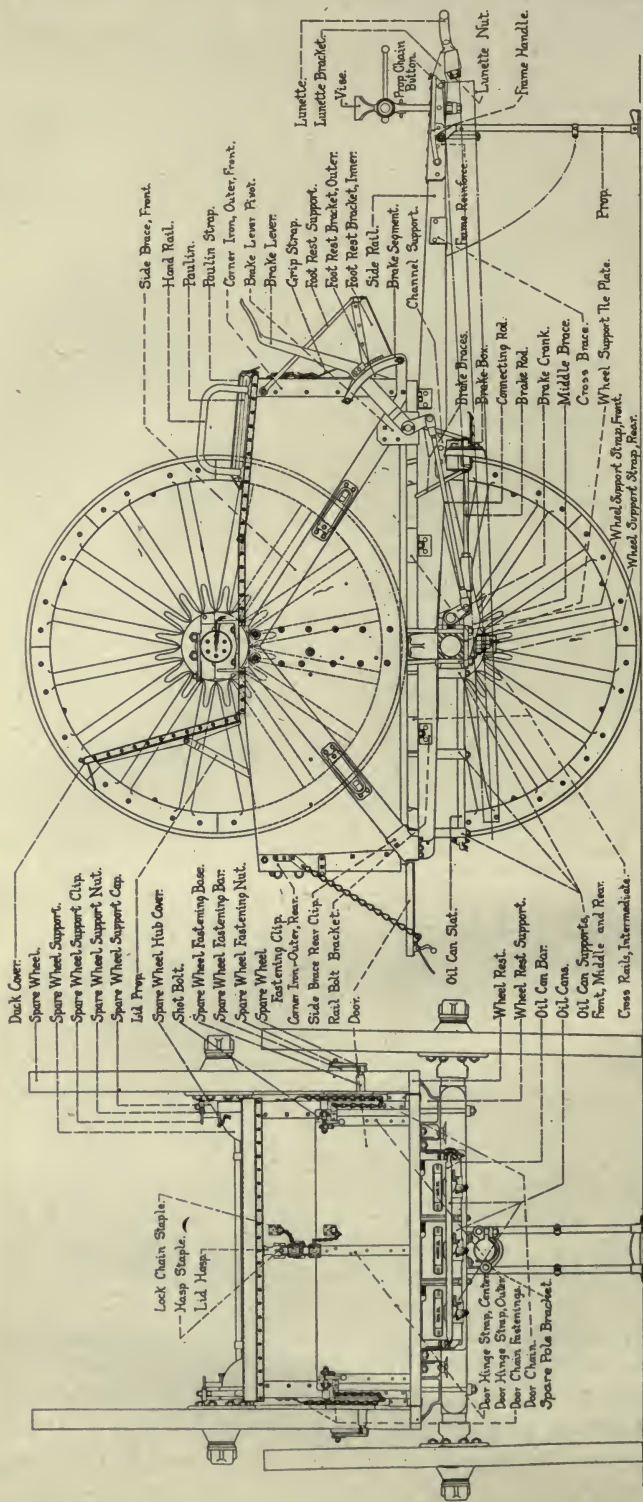
Number on store wagon.	Number on battery wagon.	Name of part.	Location, etc.	Property classification.	
				Class.	Section.
4	4	Lid prop pin.....	Screwed into lid hinge straps.....	IV	9
2	2	Lid prop plate, right.....	Screwed to sideboard.....		
2	2	Lid prop plate, left.....	do.....		
4	4	Lid prop rivet.....	In lid prop.....		
1	1	Lock chain.....	For locking oil-can bar on catch.....		
2	2	Lock-chain ring.....	On lock chain.....		
2	3	Lock-chain staple.....	Riveted to staple plate.....		
2	3	Lock-chain staple plate.....	Screwed to front and tail boards and door of battery wagon.....		
2	2	Lock washer.....	On tie-rod vertical.....		
1	1	Lunette.....	In lunette bracket.....		
1	1	Lunette bracket.....	Front end of side rail.....		
2	2	Lunette-bracket filler plate.....	Riveted to bracket.....		
1	1	Lunette nut.....	On lunette.....		
1	1	Middle brace, right.....	Riveted to axle and rail.....		
1	1	Middle brace, left.....	do.....		
1	1	Name plate.....	Riveted on left side rail.....		
16	16	Nut plate.....	Attach spare wheel fastenings.....		
1	1	Oil-can bar.....	Hinged to left side rail.....		
1	1	Oil-can bar catch.....	Riveted to right side rail.....		
1	1	Oil-can bar bracket.....	On oil-can bar.....		
1	1	Oil-can bar buffer.....	do.....		
1	1	Oil-can bar staple.....	In bracket.....		
3	3	Oil-can locking plate.....	On oil-can bar.....		
3	3	Oil-can slats (rectangular).....	On oil-can supports.....		
2	2	Oil-can slats (T shaped).....	do.....		
1	1	Oil-can slat, right (L shaped).....	do.....		
1	1	Oil-can slat, left (L shaped).....	do.....		
1	1	Oil-can staple.....	Riveted to bracket.....		
6	6	Oil-can support bolt.....	Tie supports to wagon body.....		
1	1	Oil-can support, front.....	Riveted to side rails, rear of axle.....		
1	1	Oil-can support, middle.....	do.....		
1	1	Oil-can support, rear.....	do.....		
3	3	Padlock with 1 bolt snap, 1 chain, and 1 chain ring.....	On chest for lids and for lock bar.....		
....	1	Padlock with 2 chain rings and 1 chain.....	On chest for door.....		
....	1	Partition, front.....	Transversely in box.....		
....	1	Partition, right.....	Longitudinally in box.....		
....	1	Partition, left.....	do.....		
1	1	Prop, complete, consisting of—			
1	1	Fastening pin.....	Holds prop in position.....		
1	1	Washer nut.....	On fastening pin.....		
2	2	Prop-chain clamps.....	Pinned to prop tubes.....		
1	1	Prop eye, right.....	At upper end of prop tube.....		
1	1	Prop eye, left.....	do.....		
1	1	Prop foot.....	On prop tubes.....		
2	2	Prop tubes.....	Connect prop eyes and foot.....		
2	2	Prop chains.....	On tubes and hook.....		
2	2	Prop-chain buttons.....	On body of frame.....		
2	2	Prop-chain guide.....	Guide chains.....		
1	1	Prop hook.....	On ends of chains.....		
8	8	Rail bolts.....	Fasten to side rails.....		
6	6	Rail-bolt brackets.....	Riveted to side rails.....		
1	1	Rear board.....	Rear of box.....		
1	1	Rear-brake brace, right.....	Braces channel to side rail.....		
1	1	Rear-brake brace, left.....	do.....		
1	1	Reinforce (brake segment brace).....	Inside front board (box front).....		
7	7	Reinforce plate.....	Under wheel-cleat fastenings.....		
1	1	Reinforce plate, right lower rear.....	do.....		
1	1	Segment rack.....	Riveted to brake segment.....		
2	2	Separator.....	Between brake segment and brake guard.....		
....	1	Shot bolt, left.....	At corner of door.....		
....	1	Shot bolt, right.....	do.....		
....	1	Shot-bolt bracket, left.....	Screwed to rear door.....		
....	1	Shot-bolt bracket, right.....	do.....		
....	2	Shot-bolt bracket filler.....	Under shot-bolt brackets.....		
....	2	Shot-bolt eye.....	On corner iron rear.....		
....	2	Shot-bolt stop.....	Screwed to rear door.....		
1	1	Side brace, front, left.....	On sideboard.....		
1	1	Side brace, front, right.....	do.....		
1	1	Side brace, rear, left.....	do.....		
1	1	Side brace, rear, right.....	do.....		
1	1	Side-brace front clip.....	At lower end of side brace.....		
1	1	Side-brace rear clip, left.....	do.....		
1	1	Side-brace rear clip, right.....	do.....		
1	1	Sideboard, left.....	Side of box.....		

NOMENCLATURE OF PARTS—Continued.

Number on store wagon.	Number on battery wagon.	Name of part.	Location, etc.	Property classification.	
				Class.	Section.
1	1	Sideboard, right.....	Side of box.....	IV	9
1	1	Side rail, left.....	Riveted to axle lugs.....		
1	1	Side rail, right.....	do.....		
4	4	Side strap.....	Inside of sideboards.....		
7	3	Slip tongues (door).....	In door boards.....		
7	7	Slip tongues (floor).....	In floor boards.....		
2	2	Slip tongues (hinge boards).....	In hinge boards.....		
10	10	Slip tongues (lid).....	In lid boards.....		
4	4	Slip tongues (sideboard).....	In sideboards.....		
1	1	Spare-pole fastening.....	In spare-pole support, front.....		
1	1	Fastening washer.....	On spare-pole fastening.....		
1	1	0.625 crown nut.....	do.....		
1	1	Spare-pole rest.....	Riveted to brake channel.....		
1	1	Spare-pole support, front.....	Riveted to front of frame.....		
1	1	Spare-pole support, rear.....	Riveted and bolted to axle.....		
1	1	Pin, type A, 0.866 x 2.75.....	Pins support, rear, and support cap together.....		
2	2	Spare-pole support bolts.....	Bolts support, rear to axle.....		
1	1	Spare-pole support cap, rear.....	Pinned to support, rear.....		
1	1	Swing bolt.....	In support, rear.....		
1	1	0.625 crown nut.....	On swing bolt.....		
4	4	Spare-wheel fastening bar.....	On side braces, front and rear.....		
4	4	Spare-wheel fastening base.....	do.....		
4	4	Spare-wheel fastening clip.....	do.....		
4	4	Spare-wheel fastening swing bolt.....	do.....		
4	4	Spare-wheel fastening stud.....	do.....		
4	4	Spare-wheel fastening nut.....	do.....		
2	2	Spare-wheel support.....	On top rail of box.....		
2	2	Spare-wheel support cap.....	do.....		
2	2	Spare-wheel support clip.....	do.....		
2	2	Spare-wheel support stud.....	do.....		
2	2	Spare-wheel support swing bolt.....	do.....		
2	2	Spare-wheel support nut.....	do.....		
1	1	Strap fastener, crowbar.....	On left side rail.....		
2	2	Strap fastener, grip.....	On box body.....		
4	2	Strap fastener, jackscrew.....	On cover board.....		
4	4	Strap fastener, paulin.....	On box body.....		
2	2	Stiffener.....	Riveted to front and tail boards.....		
2	2	Supply-chest supports.....	Screwed on sideboards.....		
1	1	Tailboard.....	Rear of box.....		
1	1	Tie-rod end (front).....	At upper edge of front board.....		
1	1	Tie-rod end (rear).....	At upper edge of tailboard.....		
1	1	Tie-rod, center.....	Horizontal rod through center of box.....		
2	2	Tie-rod, upper.....	Under top rail.....		
1	1	Tie-rod, vertical.....	Vertical rod through middle of box.....		
1	1	Top rail.....	Top of box.....		
1	1	Transverse brace, left.....	Inside, from middle of floor to spare- wheel supports.....		
1	1	Transverse brace, right.....	do.....		
1	1	Vertical tie-rod washer.....	At transverse braces.....		
1	1	Washer (brake).....	Under head of upper brake segment bolt.....		
1	1	Washer (brake lever).....	On brake-lever pivot.....		
6	6	Washer (oil-can bolt).....	Under heads of oil-can bolts.....		
2	2	Wheels.....	On axle.....		
8	8	Wheel-cleat fastening.....	On wheel-rest supports.....		
1	1	Wheel rest.....	On axle.....		
2	2	Wheel-rest support.....	From spare-wheel supports to wheel- support tie-plates.....		
2	1	Wheel-support strap, front, left.....	do.....		
2	1	Wheel-support strap, front, right.....	do.....		
1	1	Wheel-support strap, rear, left.....	do.....		
1	1	Wheel-support strap, rear, right.....	do.....		
2	2	Wheel-support tie plate.....	Under axle.....		

In replacements of wooden parts of these wagons it will be necessary to change locations of hasps slightly in certain cases, as well as make necessary fittings, due to the fact that wooden parts warp and shrink in service and in store and cannot be made completely interchangeable.





Battery Wagon Model of 1902 MI.



3.8-INCH HOWITZER BATTERY WAGON, MODEL OF 1902 M_I.

[Plate XII.]

DESCRIPTION OF PARTS WHICH DIFFER FROM THE BATTERY WAGON, MODEL OF 1902.

The chest, with attachments, is much stronger, braced better, and is secured more satisfactorily to the frame.

The weight of the spare wheels is carried directly by the axle instead of at the top of the chest.

The parts of the chest are bolted and screwed together, so that they may be readily disassembled if necessary.

The floor is made of matched poplar boards instead of paneling, and is raised and supported above the frame by means of a channel steel wheel rest above the axle and two parallel oak cross rails in front and two cross rails in the rear. Angles are riveted to the frame to take the eight rail bolts which secure the chest to the frame.

The ends of the wheel rest project beyond the sides of the body and lie on bronze wheel-rest supports above the axle. Wheel-support straps, front and rear, extend from the spare-wheel supports, and they are bolted to the inside of the body and pass below the axle, to which they are clamped by the wheel-support tie-plates.

Two additional tie-rods are across the center of the chest at the top. The corners of the chest are not dovetailed but reinforced by corner irons, inner and outer. Side straps are bolted through the intermediate cross rails.

The door and lids are made of matched poplar boards, except the hasp rail of the lids, which is of oak.

In the forward part of the wagon on the floor are cleats which locate the chest for spare sights and the packing chest for spare parts.

By means of supply-chest supports, which serve as guides on the inside of the sideboards of the wagon, the packing chest for supplies may be drawn to the front as an open drawer when it clears the lid of the wagon and then slid back under the top of the wagon in the closed position. It is held in the latter place by means of barrel bolts locking in two floor plates. A list of contents is on the inside of the supply chest at the rear.

3.8-INCH HOWITZER STORE WAGON, MODEL OF 1902 M_I.

The store wagon, model of 1902 M_I, is the same as the battery wagon, model of 1902 M_I, with the exceptions noted under the differences between the store and battery wagons, model of 1902.

CYCLOMETER.

The store limber of each 3.8-inch howitzer battery is fitted with a device which registers the number of miles traveled. This instrument, called a cyclometer, is mounted on the left tie-rod clamp at the rear

of the axle and is composed of a star wheel and shaft actuating a train of gears which bring figures representing 0.1 mile to 9,999.9 miles before a glass window in the usual manner of such meters.

A tally pin riveted to the wheel hub strikes the star wheel and moves it one tooth at each revolution of the wheel.

A special tie-rod clamp is issued with the cyclometer for all batteries.

NOMENCLATURE OF CYCLOMETER PARTS.

1 bracket (on special tie-rod clamp).	1 counter.
1 cover.	1 case (for counter).
1 stop.	4 case screws.
1 spring.	3 bracket screws.
1 tally shaft.	4 cover bolts with nuts and split pins.
1 washer (felt).	1 tally pin.

PADLOCKS AND BOLT SNAPS.

The padlocks furnished for each separate vehicle, as carriage, forge limber, battery wagon, store limber, or store wagon, excepting the limbers and caissons, will have keys interchangeable for all locks of that particular vehicle, but differing from all others.

Limbers and caissons are furnished with a lock, marked "AMMUNITION," which has only one key, these being universally interchangeable.

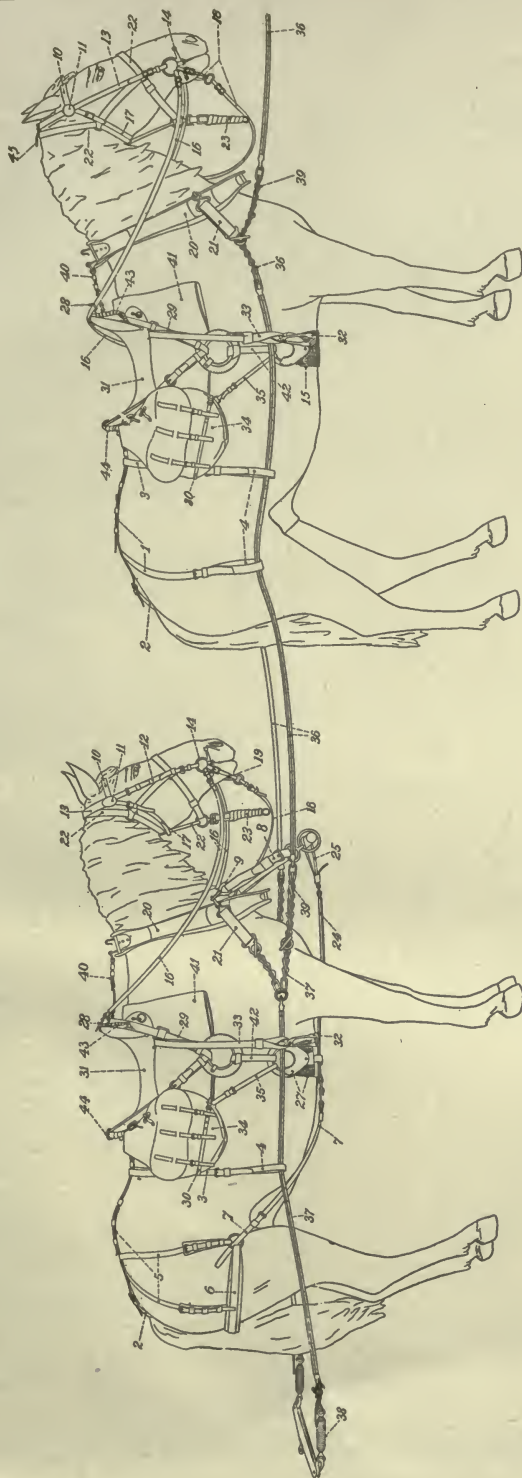
Bolt snaps for temporarily securing doors, etc., are placed where no shot bolts are provided.

THE ARTILLERY HARNESS.

[Plate XIII.]

The component parts of the artillery harness are given in the table below. Plate XIII shows the harness for the off wheel and off lead horses. The nomenclature corresponding to the numbers on the plate will be found in the table.

No. on Plate XIII.	Component parts.	Wheel.		Lead.		Property classification.	
		Near horse.	Off horse.	Near horse.	Off horse.	Class.	Sec- tion.
1-4	Backstrap and crupper, complete			1	1	IV	8
	Consisting of—						
1.	Body and hip straps			1	1		
2	Crupper dock			1	1		
3	Loin strap			1	1		
4	Trace loops			4	4		
	Backstrap hook			1	1		
5, 9	Breast strap, complete	1	1				
	Consisting of—						
8	Breast strap	1	1				
9	Breast-strap hooks	2	2				
2-7	Breeching complete	1	1				
	Consisting of—						
5	Backstrap (1) and hip straps (4)	1	1				
6	Body	1	1				
2	Crupper dock	1	1				
	Backstrap hook	1	1				
	Side-strap hooks	2	2				
3	Loin strap	1	1				
7	Side straps	2	2				
4	Trace loops	4	4				



Off Wheel Harness
Showing old model bridle

Artillery Harness

Off Lead Harness.
Showing new model bridle

No. on Plate XIII.	Component parts.	Wheel.		Lead.		Property classification.	
		Near horse.	Off horse.	Near horse.	Off horse.	Class.	Sec- tion.
10-19	Bridle, complete (old model).....	1	1	1	1		
	Consisting of—						
10	Brow band.....	1	1	1	1		
11	Brow-band ornaments.....	2	2	2	2		
12	Check pieces.....	2	2	2	2		
13	Coupling strap.....		1		1		
19	Connecting strap.....		1		1		
13	Crownpiece.....	1	1	1	1		
14	Snaffle bit ¹	1	1	1	1		
16	Reins (pairs).....	1	1	1	1		
17	Throatlatch.....	1	1	1	1		
	Bridle, complete (new model), consisting of—						
10	Brow band.....	1	1	1	1		
11	Brow-band ornaments.....	2	2	2	2		
13	Crownpiece.....	1	1	1	1		
18	Coupling strap.....		1		1		
14	Snaffle bit ¹	1	1	1	1		
16	Reins.....	1	1	1	1		
45	Crownpiece strap.....	1	1	1	1		
20	Collar, steel.....	1	1	1	1		
21	Hame tug (part of the collar).....						
40	Collar strap.....	1	1	1	1		
22, 23	Halter, complete.....	1	1	1	1		
	Consisting of—						
22	Headstall.....	1	1	1	1		
23	Tie rope.....	1	1	1	1		
24, 25	Martingale, complete.....	1	1				
	Consisting of—						
24	Martingale.....	1	1				
25	Cinch strap.....	1	1				
26-33	Saddle, complete.....	1	1	1	1		
	Consisting of—						
27	Cinchas, with reinforcers and loops.....	1	1				
15	Cinchas, without reinforcers and loops.....			1	1		
28	Lead-roin roller and strap.....		1		1		
29	Quarter straps, including rings, safes, and cincha straps.....	1	1	1	1		
42	Cincha strap, a part of the saddle quarter strap.....					IV	8
43	Coat strap, 33-inch (pommel).....	3	2	3	2		
44	Coat strap, 45-inch (cantle).....	1	1	1	1		
30	Coat strap, 60-inch.....		2		2		
31	Saddletree, leather-covered.....	1	1	1	1		
32	Stirrups (nickel steel).....	2	2	2	2		
33	Stirrup straps.....	2	2	2	2		
34	Saddlebags, pairs.....		1		1		
35	Saddlebags side straps.....		2		2		
36	Traces, lead, model of 1908.....			2	2		
	Consisting of—						
	1 trace body.....						
	1 trace cover.....						
	3 link's.....						
	1 chain.....						
	1 toggle.....						
	2 sockets.....						
	2 cones.....						
	2 filler pieces.....						
37	Traces, wheel, model of 1908.....	2	2				
	Consisting of—						
	1 trace body.....						
	1 trace cover.....						
	1 ring.....						
	2 sockets.....						
	2 link's.....						
	2 chains.....						
	2 toggles.....						
	2 cones.....						
	2 filler pieces.....						
38	Mogul spring.....						
	1 loop hook.....						
	1 ring.....						
	1 Mogul spring loop.....						
	1 locking strap.....						
39	Trace chains.....			2	2		
	Whip.....	1		1			
	Sweat leathers.....	2		2			
41	Blanket ²	1	1	1	1		

¹ Twenty curb bits with chains are issued for use in place of snaffle bits on fractious draft horses.

² In submitting and in filling requisitions, unless it is specifically stated that saddle blankets are wanted, they will not be included.

STEEL COLLARS.

SIZES AND DIRECTION FOR FITTING.

Steel collars are made in the following sizes: 2 A, 2 B, 4 A, 4 B, 5, 5 A, 5 B, 6, 6 A, 6 B, 7, 7 A, 7 B, and 8 A. The number and shape of the collar are stamped on the front side under the extension bolt. The A and B shapes have straighter sides than the numbers without letters. When issued with harness, unless otherwise ordered, 20 per cent of the collars are No. 4 A, 30 per cent No. 5, and 40 per cent No. 5 A, and 10 per cent No. 6. In requisitions the size of collars desired should be given.

The steel collar pads are made in seven different sizes: No. 0 is 4 inches wide, No. 1 is 4.5 inches, No. 2 is 5 inches, etc., to No. 6, which is 7 inches wide. The pad connections are also furnished in seven sizes, from No. 0 to No. 6. For the plain number of collar (5, 6, or 7) the regular adjustment requires a pad connection of the same number as the pad. The A and B shapes have straighter sides and take a pad connection two sizes larger than the pad—that is, it would take a No. 3 connection with a No. 1 pad, etc., for the regular adjustment in these shapes. When the collar is very wide at the top and narrow at the bottom the size of the pad connection must be increased one or two numbers to allow the collar to close easily at the bottom. In the reverse case a smaller pad connection should be used. The collar pads are numbered on the front inner side. The pad connections are numbered on the side having the round holes, which side must be kept to the front on the collar. *In requisitions for collar pads and pad connections the sizes desired must be stated.*

The buckle is made in two sizes. No. 2 is 1 inch longer than No. 1, and is used with the larger sizes of collar pad.

The correct adjustment and fitting of collars is of the utmost importance. The variety of sizes and shapes of collars, pads, pad connections, and buckles issued by the Ordnance Department is sufficient to enable any horse to be correctly fitted. Efficient supervision by officers of the fitting of collars and of the adjustment of the point of draft (trace plate) is required to secure proper results.

Table of dimensions.

SIZE OF COLLARS FITTED WITH NO. 3 PADS.

Number of collar.	Length of collar inside.	Width 6 inches down from top.	Width 8 inches down from top.	Width at draft.	Number of collar.	Length of collar inside.	Width 6 inches down from top.	Width 8 inches down from top.	Width at draft.
	Inches.	Inches.	Inches.	Inches.		Inches.	Inches.	Inches.	Inches.
2 A.....	18	6 $\frac{3}{4}$	7 $\frac{1}{2}$	8 $\frac{3}{8}$	6.....	22 $\frac{1}{2}$	7 $\frac{3}{8}$	8 $\frac{1}{2}$	9 $\frac{1}{2}$
2 B.....	18	6 $\frac{1}{2}$	7 $\frac{1}{4}$	8	6 A.....	22 $\frac{1}{2}$	7	7 $\frac{3}{4}$	9 $\frac{1}{4}$
4 A.....	19 $\frac{1}{2}$	7	7 $\frac{3}{4}$	8 $\frac{3}{4}$	6 B.....	22 $\frac{1}{2}$	7	7 $\frac{1}{2}$	9 $\frac{1}{2}$
4 B.....	19 $\frac{1}{2}$	6 $\frac{1}{2}$	7 $\frac{1}{4}$	8 $\frac{1}{4}$	7.....	24	7 $\frac{3}{8}$	8 $\frac{1}{2}$	10 $\frac{1}{2}$
5.....	21	7 $\frac{3}{8}$	8 $\frac{3}{8}$	9 $\frac{1}{2}$	7 A.....	24	7	7 $\frac{1}{2}$	9 $\frac{3}{8}$
5 A.....	21	7	7 $\frac{1}{4}$	9	7 B.....	21	7	7 $\frac{3}{8}$	10
5 B.....	21	6 $\frac{1}{2}$	7 $\frac{1}{8}$	8 $\frac{1}{2}$	8 A.....	25 $\frac{1}{2}$	7	7 $\frac{1}{2}$	9 $\frac{3}{4}$





COLLAR STRAP



COLLAR PAD CONNECTION



COLLAR PAD



BUCKLE LATCH



DRAFT SPRING



PAD HOOK



BOLT AND NUT FOR TOP CONNECTION



BOLT AND NUT FOR BOTTOM OF COLLAR



PAD BOLT AND NUT



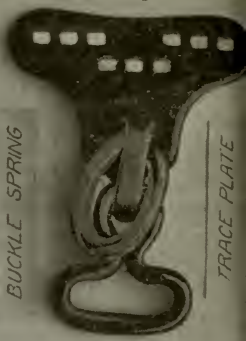
BOLT AND NUT FOR TRACE PLATE



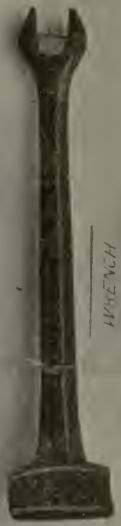
BOLT AND NUT FOR EXTENSION



BUCKLE SPRING



TRACE PLATE



WRENCH

Table of dimensions—Continued.

SIZE OF COLLAR FITTED WITH NO. 1 PADS.

Number of collar.	Length of collar inside.	Width 6 inches down from top.	Width 8 inches down from top.	Width at draft.	Number of collar.	Length of collar inside.	Width 6 inches down from top.	Width 8 inches down from top.	Width at draft.
	Inches.	Inches.	Inches.	Inches.		Inches.	Inches.	Inches.	Inches.
2 A.....	16½	5½	5½	7	6.....	21	6½	7½	8½
2 B.....	16½	4¾	5½	6¾	6 A.....	21	6	6¾	8¼
4 A.....	18	5¾	6½	7½	6 B.....	21	5¾	6½	8¾
4 B.....	18	5¾	5¾	7½	7.....	22½	6¾	7½	8¾
5.....	19½	6½	7½	8½	7 A.....	22½	5¾	6½	8½
5 A.....	19½	5¾	6½	7½	7 B.....	22½	5¾	6½	8¾
5 B.....	19½	5¾	5¾	7½	8 A.....	24	5¾	6½	8½

The table of dimensions gives the largest and smallest size that each collar can be made with the No. 3 and No. 1 pads. Adding one-half inch in length and width to the smallest dimensions given in the table will give the size of the collars when fitted with the No. 2 pads. These examples are given to show the three regular adjustments in each size of collar, but these dimensions can be varied to suit the different shapes of necks. The largest pad can be put in the top of the collar and the bottom taken in to its smallest dimensions, or the smallest pad can be put in the top and the bottom left out. While each collar can be lengthened or shortened and taken in or let out at the bottom by means of the adjustments provided, the width at the top can not be changed without using a larger or smaller pad.

In fitting irregular shapes none of the connections may give just the proper tension on the pad. In such a case use the one that comes nearest and straighten or bend the extension at the top. When the collar requires to be widened at top to relieve the pressure on the pad and make it lock easily at the bottom, open the collar wide and place a round piece of hard wood or iron, 1 inch in diameter and 2 inches long, between the connection and collar side close up to the hinge; then press the sides together and bend both sides alike so that they will be the same length at the bottom. Do not let the fulcrum rest on the pad, for it will bend it. If the collar sides require straightening to close them tighter on the pad and give more tension on the latch at the bottom, open the collar at the bottom, hook the wrench over the top of collar side, and press down the lever, treating both sides alike. Both of these operations can be performed with the collar put together.

Parts furnished for the repair of the collars with the correct names of the parts are shown on Plate XIV.

Canvas collar pads are not part of the artillery harness, but are furnished upon requisition. They are made in sizes Nos. 2, 3, 4, 5, and 6, as called for; if no size is called for they are made in equal proportions of Nos. 4, 5, and 6.

Harness issued for service in tropical countries has the metal parts which come in contact with the leather made of bronze where practicable, and steel parts covered with brass rollers or copper plated to prevent disintegration of the leather due to chemical action.

COLLAR-LIFTING DEVICE.

[Plate XV.]

This is a simple device for lifting the steel collar from the horse's neck, when, for any reason, the neck becomes sore. The straps securing it to the hame tugs afford easy attachments to or removal from the collar. By supporting the collar by canvas pads in front and in rear of the collar the pressure is removed from the surface of the neck directly beneath the collar and the weight is more evenly distributed along the neck. In case of necessity such a device, made by the organization mechanic, will allow working a horse when suffering with a sore neck.

THE ADJUSTMENT OF HARNESS.

The bridle.—The throat latch should be kept loose enough to admit the flat of the hand between it and the throat of the animal. The snaffle and curb bits should be placed low enough not to crease the corners of the mouth and not so low as to strike the tusks. The curb chain should be adjusted so as to allow two fingers to pass between the chain and the chin when the branches of the bit are in prolongation of the cheek pieces.

The collar.—The bearing surface of the collar should be fitted to suit the conformation of the horse at the bearing area of the shoulder. After measuring the length and width of the neck at the shoulder, reference to the tables of dimensions and explanations above will enable the selection of approximately the size of the collar, collar pad, and connections required. The attachment of the buckle latch, etc., should then be varied until a proper fit is obtained. The collar should not be too large or too small in length or width. To test for a proper fit, let the collar rest of its own weight against the shoulder, pull the side of the collar with one hand halfway down against the neck and mane; the fingers of the other hand should then have a snug, even fit up to the knuckles between the collar and the neck free from the mane, from the collar pad at the top around to the throat at the bottom. The proof of the fit is in the way the collar works. It is well to tag a properly fitted collar with the name of the horse to which it belongs.

The trace.—It is apparent that the point and direction of application of the draft should be at the center of the bearing area of the shoulder, where the motion of the shoulder blade is the least, and in a direction perpendicular to the shoulder. When these condi-



Collar Lifting Device.

tions exist, the collar will have no tendency to choke the horse or bear down on its neck. The highest adjustment of the trace plates will be best adapted for all horses.

The saddle and breeching.—The saddle should have the greatest bearing area possible over the middle of the horse's back. The saddles are generally placed too far forward, and with most horses it will be found that the back strap should be buckled in its shortest adjustment with the crupper resting closely but not tightly against the dock, so as to keep the saddle from being placed dangerously near the withers. For ordinary work, the cincha when fastened should admit the flat of the fingers easily under the quarter strap and ring safe. Pressure should not be brought on the trace loops with the horses in draft, but the bottom of the loop should be 1 or 2 inches below the traces. The body of the breeching performs the same office in holding the vehicle back that the collar does in moving it forward and the same principles of direction and point of application of force apply. The place of least motion of the thigh bone is at its pivot or the joint of the hip. The body of the breeching should therefore rest against the thigh at the joint of the hip, and the hip straps should be adjusted to hold it in this position.

The side straps should be of such length that the body of the breeching will check the carriage before the singletree touches the hocks. A satisfactory adjustment can be made by hitching the horse to the carriage and having him put his weight into the collar. Then insert the width of the hand and extended thumb between the body strap and the thigh and buckle the side straps to this length.

THE CARE AND PRESERVATION OF LEATHER.

Attention is invited to the following:

"It is forbidden to use any dressing or polishing material on the leather accouterments or equipments of the soldier, the horse equipments for cavalry, or the artillery harness except the preparations supplied by the Ordnance Department for that purpose." (A. R. 293 of 1913.)

REASON FOR OILING LEATHER.

Leather, as it comes from the tannery in manufacture, is hard, rough, inflexible, and readily absorbs water. To remove these undesirable qualities and render the leather soft, pliable, flexible, and impervious to water, to increase the strength and toughness of the fiber, and to give the leather such a surface color and finish as will make it most sightly and suitable for the purpose for which intended, the manufacture is continued by hand stuffing it with a lubbing made of pure cod-liver oil and beef tallow, which the experience of carriers has shown to be the best material for this purpose. This dubbing is thoroughly absorbed by the leather, penetrating it completely, and is not merely limited to the surface.

The russet leather now used by the Ordnance Department in the manufacture of all leather equipments is pure oak tanned, of No. 1 tannage and finish, hand stuffed with a light dubbing made of pure cod-liver oil and beef tallow to preserve the leather. This leather as it comes from the manufacturer contains enough oil to materially improve its quality and prolong its life, but not enough to soil the clothing if the equipment is properly cared for. No oil whatever is added to the leather in the manufacture of the equipments at the Government arsenals.

CARE OF RUSSET LEATHER.

Leather equipments which have become wet should be dried in the shade. Wet leather exposed to the direct rays of the sun or to the heat of a stove or radiator becomes hard and brittle. Only cool or lukewarm water should be used on leather; the use of hot water is prohibited.

When russet-leather equipments become soiled in service they should be cleaned by carefully washing the leather with a sponge moistened with a heavy lather made of clean water and Castile or Frank Miller's soap, and then rubbing vigorously with a dry cloth until the leather is completely dry.

If the leather becomes harsh and dry from exposure to water or other causes, clean as above described, and while the leather is still slightly moist apply a light coat of neat's-foot oil by rubbing with a soft cloth moistened (not *saturated*) with the oil. If it is found that too much oil has been used the surplus can be readily removed by rubbing with a sponge moistened with naphtha or gasoline. But these oils are not issued for this purpose.

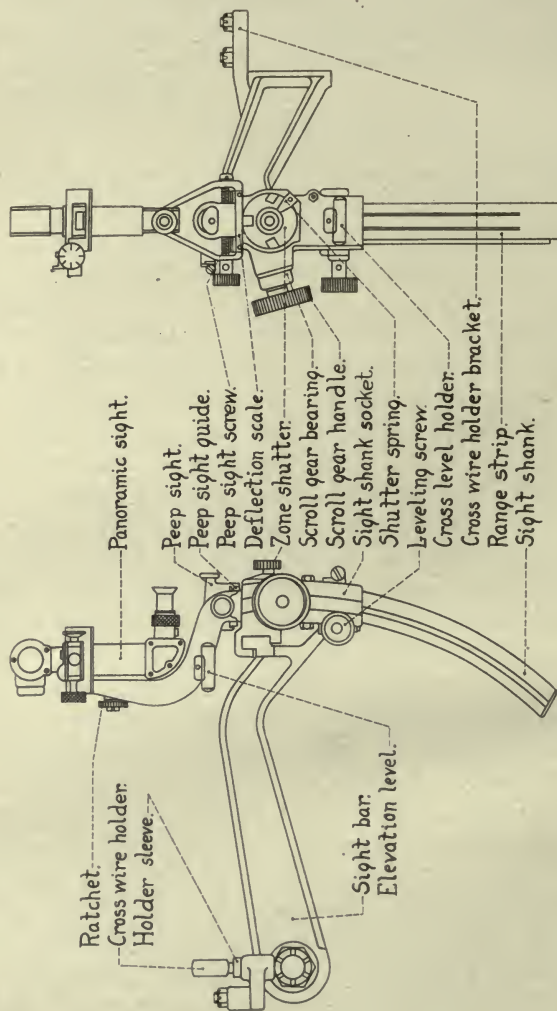
Where a polish is desired, the leather should first be thoroughly cleaned and then the leather polish or dressing supplied by the Ordnance Department should be applied sparingly and thoroughly rubbed in with a soft, dry cloth. Scars, cuts, or abrasions of the leather may be improved in appearance but not obliterated by similar use of the leather polish.

Russet leather may be cleaned, oiled, and polished as described above, but it should be noted that if more than a light coat of oil be given the leather will be greatly darkened and will quickly soil the clothing. No method of cleaning will restore the original light color of the leather or remove stains or discolorations.

CARE OF BLACK LEATHER.

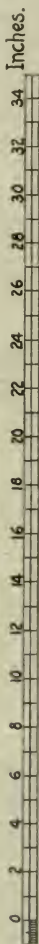
To clean and dress black leather, wash it in water (lukewarm preferred) with Castile soap. An old horse brush will be found very satisfactory for applying the soap and water. Dry in the shade; when almost dry, apply the blacking, rubbing it in thoroughly.





3.8-Inch Howitzer Carriage, Model of 1915

Sight Assembled.



Dry in the shade and then apply neat's-foot oil with a sponge or rag, rubbing in well until the leather is soft and pliable.

When dry, a certain amount of oil and blacking will exude from the leather; this should be rubbed off with a dry cloth.

SIGHTS.

FRONT AND REAR SIGHTS.

The arrangements for sighting and laying the piece include a peep sight in the rear with a corresponding front sight carrying cross wires, and a panoramic sight. (Plate XVII.)

The front sight consists of two cross wires set at an angle of 45° to the horizontal in the circular bore of the cross-wire holder and held in place by the cross-wire ring and the cross-wire retainer. The shank of the holder is threaded with 32 threads per inch, which allows it vertical movement in the holder sleeve. The outside of the holder sleeve is threaded with 30 threads per inch, which allows it a vertical movement in the cross-wire holder bracket. This bracket is keyed and attached by studs to the trunnion cap, left.

A one-eighth inch split pin passes through the bracket and through slots in the cross-wire holder and holder sleeve, and fixes the cross-wire holder in a plane normal to the line of sight, the slots allowing vertical adjustment by the differential threads of the sleeve. A sight bar is keyed to the left trunnion bushing of the rocker and secured by a nut. This bar extends to the rear and supports the peep and panoramic sights.

The rear end or head of the sight bar is provided with circular guides cut with the line of sight, howitzer at 0° elevation, as an axis, and upon these guides a socket for the sight shank is mounted. A clip formed on the front of the lower end of the shank socket forms a bearing for a leveling screw, whose threads engage worm-gear teeth cut in the lower guide of the sight bar. On the rear of the lower end of the shank socket is a seat for the cross level. Turning the leveling screw rotates the sight shank socket about the line of sight and in a plane perpendicular to it. This permits the sight shank to be brought vertical, thereby correcting for any difference in the level of the wheels.

The sight shank is an arm curved to the arc of a circle, the center of which lies in the axis of the trunnions; it slides in guides in the shank socket and is moved up and down in elevation by a scroll gear seated in a boss upon the shank socket and engaging in a rack cut upon the left side of the shank. The scroll gear is held in mesh with the rack by the scroll-gear spring.

The sight shank may be dismounted from the sight shank socket, or a considerable change in elevation may be quickly effected by

pulling the scroll-gear handle to compress the spring and disengage the scroll gear from the rack, and then sliding the sight shank through the shank socket by hand.

A German silver range strip fits in a dovetailed seat cut in the rear face of the sight shank, and is divided into three range scales, each graduated in yards to correspond to the ranges of the particular zone used. Mounted upon a boss on the rear face of the sight shank socket and held in place by a shutter trunnion is a notched zone shutter, the notches being so arranged that only the range scale to be used is exposed. The knurled knob is used for turning the zone shutter to the desired zone, in which position it is held by a tooth of the shutter spring engaging a notch in the shutter. Raised figures on the shutter indicate the number of the zone of the range being read.

A shank-socket cover is provided to close the inner side of the shank socket. A spring plate attached to the front of the shank recess in the socket supports two plungers which are actuated by springs to force the shank against the front wall of the socket, thus taking up the play of the parts.

The upper part of the sight shank is fashioned into a deflection guide and mounting for the peep sight and is prolonged to form a support for the panoramic sight. The peep-sight guide is located in an opening in the sight shank and is perpendicular to the line of sight. The peep sight is secured by clips to this guide and is traversed along it by the peep-sight screw. The latter passes through a tapped hole in the peep sight and is supported at each end in bearings in the sight shank. The screw is turned by a knurled head at its left end. The peephole is 0.125 inch in diameter.

The deflection scale is attached to the rear face of the peep-sight guide and the index for the scale is on the peep sight. The graduations are in *millièmes*, or points equivalent to one one-thousandth part of the range. There are 45 mils upon each side of the zero and the scale is marked from left to right as follows:

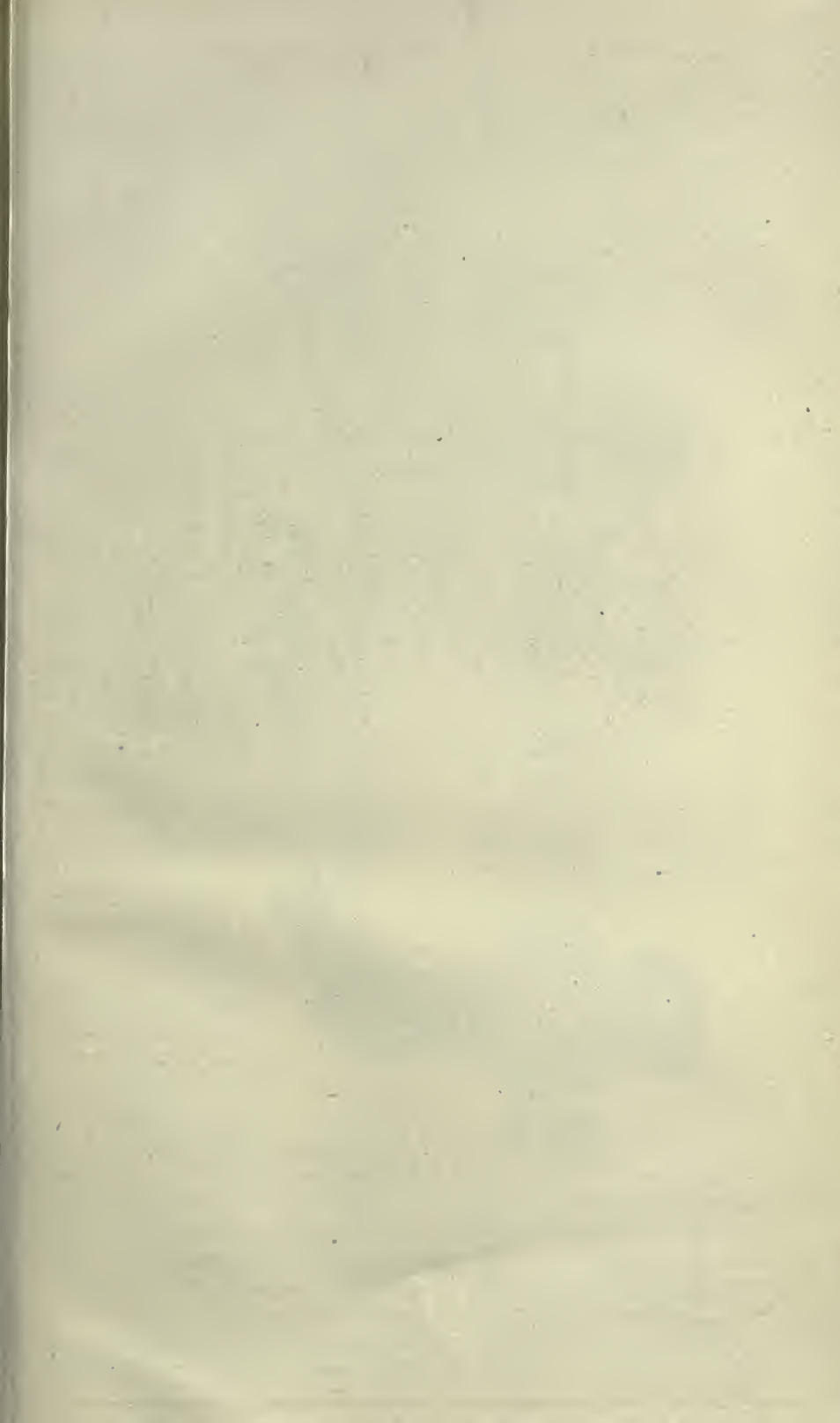
40 20 0 80 60

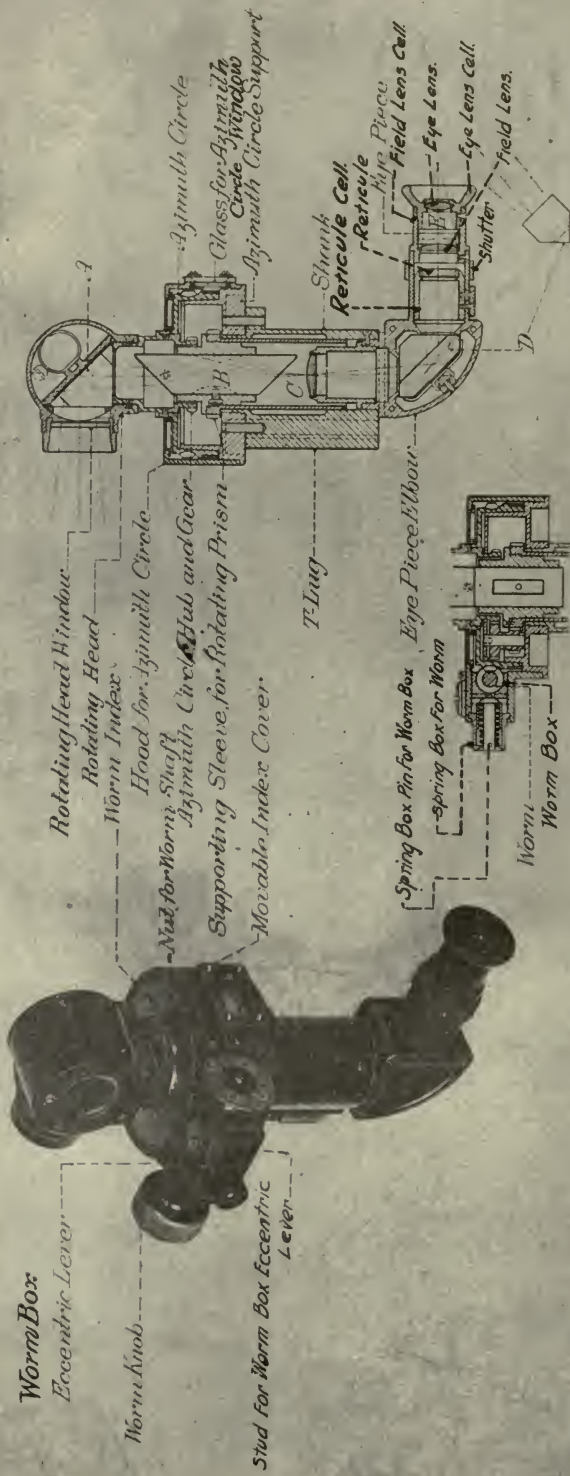
the actual mils being

40 20 0 6380 6360

thus making deflection readings on this sight uniform with those of the panoramic sight and the battery commander's telescope. The scale has a short longitudinal adjustment by which the zero of the scale may be located so as to bring the line of sight parallel to the plane containing the axes of the howitzer and cradle.

The sides of the upper sight shank converge above the peep sight and form a support for the panoramic sight. This support has a vertical T slot into which the guide lug of the panoramic sight fits. A clamp screw with a ratchet head is seated in the support and holds





Section through Gears

Panoramic Sight.

Model of 1904.

the panoramic sight in position by forcing it against the ways of the support. A small spring plunger detent seated in the sight shank bears against the ratchet head of the clamp screw and fixes it in position.

Upon the left side of the upper sight shank is attached a level holder in which is mounted an elevation level.

In firing, the sight is left in its seat. In operating the quick return mechanism the cradle and howitzer are shifted, but the rocker and sight settings are not disturbed.

THE PANORAMIC SIGHT, MODEL OF 1904.

[Plate XVII.]

The panoramic sight is a vertical telescope so fitted with reflecting prisms that the gunner with his eye at the eyepiece, which is fixed in a horizontal position, may bring into the field of view an object situated at any point in a plane perpendicular to the axis of the telescope.

The details of the optical part of the instrument are shown in Plate XVII, and comprise the rotating head prism A, the rotating prism B, the objective lens C, the lower reflecting prism D, and the eyepiece E. The rays coming from the object are reflected downward from the prism A into prism B, which rectifies them; after their passage through the objective lens C, the prism D reflects them in such-a way that there is presented to the eyepiece E a rectified image, which the eyepiece magnifies. The prism B is of rectangular cross section. Its peculiarity is that on rotation about its longitudinal axis the image of an object seen through it turns with twice the angular velocity of the prism. As, therefore, the prisms A and B are so mounted as to rotate about this axis, prism B following A with one-half the angular velocity of the latter, the image always remains as it would appear to one observing it directly with an ordinary terrestrial telescope.

The image formed by the objective lens would naturally be reversed and inverted. The lower inclined faces of the prism D by cross reflection transfer the rays to opposite sides of the axis, thus correcting the reversal. The correction of the inversion is accomplished by the combined action of the three prisms A, B, and D, the nature of the action varying with the different positions of the prisms. In the position shown on Plate XVII prisms A and D act as parallel reflectors, and they without the lens system would present an erect image. Prism B, however, inverts the rays and corrects the inversion produced by the objective lens. It will be noted the effect would be the same whether the prism B occupies the position shown on the plate or be revolved 180° from that position. This latter position is the one it would assume if the prism A were rotated through 360° . If the prism A be now rotated through 180° the

prisms A and D would form two reflectors set at right angles, and would give, without the lens system an inverted image, and in conjunction with the lens system an erect image. Prism B in this case will occupy a position 90° from that shown on the plate, in which position it causes no inversion, but counteracts the inversion produced by prism D.

A glass reticule marked with cross lines is located in the focal plane of the instrument, with the intersection of the cross lines coincident with its optical axis. No provision is made for changing the focus of eyepiece or objective lens. As issued, the instrument is focused for the usual range and the average eye. The magnifying power of the instrument is four; the field of view is 10° .

The mechanical construction of the instrument is as follows: The body consists of a shank, provided on its front surface with a T lug which fits into a corresponding slot in the head of the shank of the rear sights and is held in that position by a clamp screw, which is locked by a detent and ratchet, thus firmly securing the instrument in place. To the lower end of the shank is screwed the eyepiece elbow, forming a housing for the prism D and the eyepiece E. The latter projects to the rear just above the peep sight of the rear sight. To the upper end of the shank is screwed the azimuth-circle support, to which is screwed the hood for the azimuth circle, forming a seat for the rotating mechanism of the sight. The opening in the rotating head is closed by the rotating head window, which forms a dust guard. The rotating head prism A is mounted opposite this opening. The lower end of the rotating head is seated in the azimuth circle hub and gear. A worm located in bearings in the hood for azimuth circle engages in a worm rack cut on the azimuth circle. The rotating prism B is secured in the upper end, and the objective C in the lower end, of the supporting sleeve for rotating prism resting in the azimuth circle hub and gear. The upper end of the supporting sleeve for the rotating prism and the lower end of the azimuth circle hub and gear have gears which engage in a double pinion seated in the azimuth-circle support. The gears and pinions are calculated so that the angular velocity of the rotating head is twice that of the rotating prism B and is in the same direction. The motion of rotation is transmitted from the worm to the azimuth circle, thence to the azimuth-circle hub and gear, thence to the pinion, and through it to the supporting sleeve for rotating prism. The amount of motion of the rotating head prism is indicated by a graduated scale on the perimeter of the azimuth circle, visible through the glass azimuth-circle window in the rear face of the hood for the azimuth circle. The zero of the scale and the movable index cover on the hood for azimuth circle are located so that the line of sight of the panoramic sight is parallel to that of the rear sight, and consequently to the axis of the gun, when both sights are set at 0 elevation and deflection.

The scale is formed by dividing the circumference into 64 equal parts. One complete turn of the worm moves the rotating head prism through one of these divisions, or $\frac{1}{64}$ of a circle. The rear end of the worm carries the worm index with circumference graduated into 100 equal parts to form a micrometer scale. One of these subdivisions, therefore, equals $\frac{1}{100}$ of a division of the main scale, or marks a movement of the rotating head prism and line of sight through $\frac{1}{6400}$ of a circle. An angular movement of the line of sight through $\frac{1}{6400}$ of a circle corresponds very closely to a lateral displacement of $\frac{1}{1000}$ of the range. Practically, the subdivisions of the deflection scale on the panoramic sight are considered as points equal to $\frac{1}{1000}$ of the range and are called millièmes or mils.

The reading of the deflection scale or the size of an angle is given in the units of the worm index as 2763, 1521, etc., meaning $\frac{2763}{6400}$, $\frac{1521}{6400}$, etc., of 360° . The alternate divisions of the main scale are numbered in a clockwise direction 0, 2, 4, etc., to 62, inclusive. In reading the deflection scale, therefore, hundreds are read directly from the main scales and tens and units from the worm index. At 0 the line of sight is parallel to the vertical plane through the axis of the gun; at 16 (or 1,600 mils) it is perpendicular to that plane and pointing directly to the right, etc.

The worm index forming the micrometer scale is secured on a coned seat on the end of the worm by a nut and is held against rotation on its seat by friction. This arrangement permits the 0 of the worm index to be set opposite the index mark on the casing without movement of the worm in adjusting the sight.

The worm is held in contact with the worm gear on the azimuth circle by a spring, and is arranged so that it may be disengaged from the worm gear by movement of a worm-box eccentric lever. When disengaged, the line of sight may be rapidly oriented to approximately the desired direction, the worm then thrown into gear, and finer adjustments made by turning the worm knob.

All panoramic sights have been made interchangeable, so as to fit in seats.

The following device for illumination of the cross lines of the reticule of panoramic sights is used:

A small slit is cut in the eyepiece elbow and the reticule cell on the side of the sight next the gun. A shutter is provided which encircles the eyepiece elbow opposite the slit, affording means for closing. On some sights this shutter is provided with a transparent celluloid window to prevent the entrance of dust. On the later sights a glass window is fitted in the side of the eyepiece.

For illumination at night electric flash lights are used. They should be held close to the illuminating slot or window.

Panoramic sights of this model have been adopted for future manufacture. This sight is practically the same as the panoramic sight, model of 1904, except for certain improvements in its construction and in the following details:

(a) The rotating head is provided with an elevating mechanism consisting of a worm meshing in a worm segment, by means of which the line of sight may be moved 300 mils up or down in a vertical plane. A micrometer head is provided on the elevation worm, by means of which the variation from a horizontal position may be read off in mils.

In using this sight for direct fire, care must be taken that the rotating head be set at 300 mils.

(b) An open sight is located on the right side of the rotating head to assist in giving general direction to the gun.

(c) The throwout for the azimuth worm is of different construction from the model of 1904 sight, the mechanism being nearly dust proof.

(d) An additional mechanism, called the deflection mechanism, has been provided for laying off deflection independent of the setting of the large azimuth circle. This additional means for setting deflection is provided so that the main deflection, correct for the first gun, may be set off on the large azimuth circle, the same for all guns. The correction necessary for the individual guns, whether it be the ordinary deflection difference or any other correction, is set off on the shorter deflection scale. Abbreviations for "Increase," "Diminish," "Left," or "Right" are added to facilitate using this scale, the abbreviations "Inc." and "Dim." referring to the changes in the reading of the azimuth scale, while "L" or "R" refers to resultant changes in the direction of the sheaf of fire.

In using this sight for direct fire, care must be taken that the deflection mechanism be set at 0.

THE RANGE QUADRANT.

[Plate XVIII.]

The range quadrant consists of the quadrant bracket, rocker, body, scroll gear, range drum with range scales, range and cross levels with suitable leveling screws.

A quadrant bar, keyed to the right trunnion, has dovetailed guides, into which the quadrant bracket fits and is held by a spring catch. Two bracket fulcrums screwed into the arms on the bracket project into bearings in the ends of the rocker, assembling the latter

to the bracket and at the same time permitting rotation of the rocker about an axis joining the centers of the bracket fulcrums. As assembled, the axis of motion is parallel to the axis of the howitzer. A projection below the rear end of the rocker forms a seat for a leveling screw, the axis of which is in a plane perpendicular to the axis of the piece. The knurled head of this screw projects to the right and its threads mesh in the segment of a worm wheel cut on the quadrant bracket. This leveling screw is thus arranged to rotate the rocker on its trunnions and, in connection with the transverse level mentioned below, enables the quadrant to be brought into a vertical plane parallel to the axis of the howitzer, and consequently to correct for difference of level of wheels and to give true quadrant elevations. At the front end of the rocker is a seat for a fulcrum pin, which forms the center of motion of the quadrant body. At the rear end of the rocker a curved arm projects upward and has circular racks cut on its front and rear edges. This curved arm passes through a slot in the body and the centers of the racks coincide with its center of motion.

The body, as stated above, is pivoted on the rocker. Its rear end affords a housing for the quadrant-elevating gear and a seat for the range drum.

The elevating gear consists of a scroll gear, meshing with the rear circular rack of the rocker. The scroll gear is actuated by a knurled scroll gear handle which projects upward and to the rear. Turning the handle rotates the body on its fulcrum pin, moving its rear end up or down on the curved arm of the rocker. The scroll gear is pressed against its rack by a spring, and an extensive change of position of the quadrant body may be rapidly made by pulling on the handle to disengage the gear from the rack and then moving the body by hand to the desired position.

The range drum is assembled on the steel shaft seated in the quadrant body; this shaft carries a pinion which meshes with the front circular rack on the curved arm of the quadrant rocker. The range drum is held on the shaft between two steel friction disks. A nut screwed on the shaft clamps the disks in position, and a lock screw in the end of the shaft prevents the nut from unscrewing. The outer friction disk is saucer shaped, having a milled edge and is split radially to give a spring action. The inner friction disk is connected to the shaft by lugs projecting into a slotted collar. This construction forms an adjustable lock for the range drum. A spiral spring, the tension of which serves to take up any lost motion in the arrangement, is connected at one end to the inner friction disk by a pin. It is wound around the hub of the body and secured to the hub in a slot cut to receive it. Should the range drum get out of adjustment, it is merely necessary to remove the lock screw and nut and readjust the range

drum between the friction disks. A range quadrant wrench for use on the lock screw and nut is issued with each carriage. Special care should be taken to obtain the proper adjustment to prevent the range drum from slipping during firing.

The face of the range drum for the third zone, which is visible on the right side of the quadrant, is graduated up to 6,600 yards.

The least division is 50 yards, and the scale is dimensioned at each 200 yards. Divisions smaller than 50 yards may be readily made with the eye. The range drum is always in gear through its shaft and pinion with the rack on the curved arm of the rocker, and any change in position of the quadrant body with reference to the rocker arm is registered by the scales.

On the periphery of the drum are two other scales for the first and second zones. The zone shutter operated by the shutter screw has an index on a beveled surface for the third zone range scale mentioned above, and a straight-edge index for the first and second zones. The shutter is so designed that when the index is in position for one zone scale the others may not be read accidentally.

The elevation level holder is seated on the forward part of the body, with its front end pivoted on the fulcrum pin of the latter. Its rear end is finished with a segment of a worm wheel, cut with the fulcrum pin axis as a center, which meshes with a vertical micrometer screw seated in the body. The level holder is given a rotation on its fulcrum pin relative to the body by this micrometer screw. The amount of this relative motion is measured by a level scale, consisting of an ordinary circular scale dovetailed in the body with an index on the level holder supplemented by a level micrometer disk on the upper end of the micrometer screw. The level scale is graduated in sixty-fourths of the circumference, and one complete turn of the screw moves the level holder through one of these divisions. The level micrometer disk on the head of the micrometer screw has 100 divisions, so that one of these divisions corresponds to the mil ($1/1000$ of the range) usual on sight scales. The divisions of the circular scale are marked "2," "3," "4," and "5," and in connection with the level micrometer disk are read 200, 300, etc., plus the indication of the latter. The "3" or 300 mark corresponds to the mean or "zero" position of the level holder.

The actual angle of site is the angle made with a horizontal plane by the right line joining the howitzer and the target; it is the difference between the reading on the scale and 300. The level holder is fitted with two spirit levels, sensitive to 0.1 of an inch or 5 minutes of an arc. The longitudinal or range quadrant level is located so that its axis is parallel to the axis of the howitzer when the level scale is set at 3 and the range disk at zero.

The axis of the transverse or cross level is perpendicular to that of the range level and also to the plane of motion of the quadrant body. The cross level in connection with the leveling screw enables the quadrant to be kept vertical, correcting for difference of level of carriage wheels. The range level in connection with the elevation holder and its level screw is used as a clinometer to correct the range scale readings for angle of site; in connection with the quadrant body it is used as the quadrant level. For purposes of reference, these levels are designated as cross level and the range level, and their respective screws as the leveling screw and the micrometer screw; the scale pertaining to the latter screw is called the level scale; the range level is also referred to at times as a quadrant or angle of site level.

USE OF SIGHTS AND QUADRANT.

The powder charges and sighting arrangements are prepared so that firings may be carried on in three different zones. The ranges for each zone extend from 0 to maximum range for the particular zone. As far as the sights and quadrants are concerned they are used the same for each zone, the only precaution necessary being that the zone shutters for the rear sight and range quadrant must be set so as to permit reading the proper scale.

USE OF THE REAR SIGHT.

When used in connection with the front sight its use is ordinarily limited to direct fire only. For this purpose set the sight scale at the ordered range and the peep sight at the ordered deflection and correct for difference of level of wheels. Elevate and traverse until line of sight through peep and front sights is on the target. When used in connection with the panoramic sight it may be used for direct or indirect firing.

USE OF THE PANORAMIC SIGHTS, MODELS OF 1914 AND 1915.

For direct aiming.—Set the rear sight at the required elevation and correct for difference of level of wheels; set off the desired deflection on the azimuth circle of the panoramic sight; bring the crosslines of the sight upon the target by means of the elevating and traversing devices of the carriage.

In using the model of 1915 sight for direct fire, care must be taken that the rotating head be set at 300 mils and the deflection mechanism at 0.

For indirect aiming.—Set the rear sight at the required elevation and make correction for difference of level of wheels; set the azimuth circle of the panoramic sight at the deflection ordered. Lay the howitzer for deflection by directing the vertical line of the panoramic sight at the auxiliary aiming point, the elevation of the howitzer being given by using the range quadrant. The angle of deflection to be set off on the azimuth circle of the panoramic sight is the same

as the angle made by joining the target and the auxiliary aiming point with the sight.

For measuring ranges.—Distances or ranges may be roughly calculated from readings made by two panoramic sights mounted on their howitzers, as follows:

Direct the howitzers on the target; then sight the panoramic sights on each other. The angle at the target subtended by the line connecting the two howitzers is then 3,200 mils minus the sum of the actual angles in mils measured at the howitzers.

If B is the distance between the howitzers in yards, then range equals B multiplied by 1,000 divided by the number of mils in the angle at the target.

The accuracy of this method increases as B becomes smaller so long as the instruments can be read correctly.

USE OF THE RANGE QUADRANT.

To measure the angle of site.—Lay the howitzer upon the target by means of the tangent sight or panoramic sight when these are set at zero elevation and deflection; set the range scale at zero; bring the bubble of the cross level to the center by means of the leveling screw; bring the bubble of the range level to the center by means of the micrometer screw; the reading of the level scale less 300 is the angle of site in units of the scale. If the target is below the piece, the angle of site is negative; if above, it is positive.

To give quadrant elevations with the range quadrant.—Measure the angle of site as above; the index of the zone shutter should be placed opposite the proper zone scale and the range scale set to the desired range by actuating the scroll gear handle; bring the bubble of the range level (level scale indicating angle of site) to the center by turning the elevating handwheel of the carriage. The howitzer will then have the elevation (corrected for angle of site) corresponding to the range. Where the target can not be seen from the carriage, the angle of site must be measured by auxiliary means as with the B. C. telescope.

CARE OF SIGHTS AND QUADRANT.

Whenever convenient, and especially when in garrison and not in use, the front and rear sights with the range quadrants and panoramic sights should be removed from the carriages and kept in some dry place, as in the barracks storeroom or office.

CARE OF THE FRONT AND REAR SIGHTS.

For traveling the sight shank is withdrawn from the shank socket, covered with the cover for the sight shank, and placed in its packing in the rear trail box. Covers are provided to protect the surfaces of the shank socket and the front sight and should be slipped over these parts when the sight is removed.

All parts of the sight shanks and shank sockets should be kept clean, free from rust, and lightly oiled. When stored or not used for short periods they should be thoroughly cleaned and well coated with light slushing oil. Should any part become rusted, it should be carefully cleaned by softening the rust with kerosene oil and rubbing with a soft pine stick.

In handling all parts of sights care must be exercised to avoid injuring them by dropping, striking them upon or with other parts.

For instructions for the replacement of level vials see instructions given under the heading "Care of the range quadrant."

CARE OF THE PANORAMIC SIGHT, MODELS OF 1904 AND 1915.

These sights are delicate instruments and must not be subjected to any rough usage, jars, or strains. In firing they remain in position on the carriage; in the field, when not in use, they are kept in the padded leather cases prepared for them on the rear of the main shield.

To obtain satisfactory vision, the glasses must be perfectly clean and dry. The T lug on the sight and the slot forming its seat should be kept lightly oiled as a preventive of rust. The worm and worm rack should be oiled with vaseline. When dust accumulates on the pointers it should be removed by a fine camel's-hair brush in the hands of an experienced person.

To disassemble the worm mechanism of the model of 1904 sight for cleaning, throw out the worm-box eccentric lever, disengaging the worm from the worm gear of the azimuth circle. Insert a pin in the radial hole in the spring-box pin. Throw the worm-box eccentric lever back and engage the worm in the azimuth circle. Push the spring box toward the worm knob about three-eighths inch and then lift it straight out. Take out the eccentric-lever stud and remove the worm-box eccentric lever. Pull out the dowel in the worm-box pin with a pair of pliers and drive out the worm-box pin. Then pull out the worm box and worm complete. The worm may be cleaned without further disassembling. Assemble in reverse order.

The teeth of the worm wheel may be cleaned without disassembling the hood.

To clean the rotating-head window and the front face of the rotating-head prism, unscrew the window cell in the rotating head. Do not remove the rotating-head window from the window cell.

To clean the reticule and eyepiece lenses, remove the screw holding the eyepiece to the eyepiece elbow and unscrew the eyepiece. To disassemble the lenses, remove the set screw on the underside of the eyepiece and unscrew the eye-lens cell. The field lens is held in place by a retaining spring, both of which may drop out as soon as the eye-lens cell is disassembled.

In assembling note that the flat surface of the field lens of the eyepiece is placed next to the reticule. Do not remove or change

the adjustment of the reticule. Its rear surface may be cleaned with a camel's-hair brush after the eyepiece has been removed.

In panoramic sights of serial numbers after No. 752 the exposed optical elements and all nonmoving joints are sealed and no attempt should be made to remove them.

For serial numbers 873 and up, the slight change in the appearance and construction of the elbow and rotating head is made for the purpose of making these parts dust and moisture proof.

CARE OF THE RANGE QUADRANT.

The directions for the care of the range quadrant are practically the same as those for the care of the different sights. The parts should be kept clean, free from rust, and bearings lightly oiled. When stored they should be coated with light slushing oil.

To clean the micrometer screw, unscrew about two turns the small screw in the center of the level micrometer disk; drive out the taper pin holding the screw bushing from the rear; tap the screw in the thread of the disk. This forces the micrometer screw down and loosens the disk. Remove the small screw, pull out the micrometer screw and bushing; clean, oil with heavy oil, and assemble in the reverse order. Then adjust the level scale at 300, micrometer scale at 0.

Extra glass level vials assembled in brass tubes, to replace broken vials in sights and range quadrants, except for the range levels of quadrants, will be issued on requisition. In case the range level of the range quadrant requires replacement the range quadrant will be turned in to an arsenal designated by the armament officer.

Only ordinary tools, such as a hammer, and a punch or a piece of wire are required for the removal of pins from level caps in order to replace vials. All pins on level caps are driven in toward the center of the instrument. They should be driven out in the opposite direction. Four adjusting screws in the vial tubes are used for adjusting the tubes in their holders.

ADJUSTMENT OF SIGHTS AND QUADRANT.

The sights are correctly adjusted when, at zero elevation and deflection, the line of sight is parallel to the axis of the bore.

The range quadrant is correctly adjusted when, with the range disk set at zero, level scale set at 300, and axis of howitzer horizontal and corrected for difference of level of wheels, the level bubble of the range level stands in the center of its vial. In adjusting sights, the panoramic sight should first be corrected. If the rear sight is adjusted first, it will require readjustment if the subsequent adjustment of the panoramic sight causes a change in position of the rear-sight range strip.

TO ADJUST THE PANORAMIC SIGHT, MODELS OF 1904 AND 1915.

Direct the panoramic sight by means of the worm knob and scroll gear handle until its line of sight is parallel to the axis of the bore. The method of determining when this condition of parallelism exists is described hereafter. Without disturbing the direction of this line of sight, move the worm index of panoramic sight and the range strip of the rear sight until the zero marks come opposite their respective indices. The worm index may be moved after loosening the nut on the end of the worm. This nut may be loosened by the combined teat wrench and screw driver issued for the purpose. If the worm index can not be readily removed, grasp the sight by the worm index, release the worm from the worm gear of the azimuth circle, and gently tap the exposed end of the worm with a small piece of wood or soft metal.

To locate the index of the panoramic sight opposite the zero of the scale, loosen the four screws that hold the movable index cover in place and move this cover until the index is properly located; then tighten the screws. Movement of the range strip of the rear sight is made possible by a dovetail slot in the shank in which the range-strip screw can be moved when the nut has been loosened.

The principle for adjustment of the 1915 panoramic sight is the same as for the 1904 model. The actual method used is slightly different, due to the different construction used.

TO ADJUST THE FRONT AND REAR SIGHTS.

The rear-sight shank is set at zero elevation and the direction of the line of sight is changed by means of the peep-sight screw and by altering the front sight until the line of sight is parallel to the axis of the bore. The method of determining when this condition exists is given below. The deflection scale on the sight shank is then shifted until its zero registers with the index on the peep sight. This movement of the deflection scale is provided for by elongated holes in the scale, through which pass the screws which clamp it in position on the sight shank. Movement of the front sight is accomplished by turning the crosswire holder sleeve after first removing the split pin.

TO ADJUST THE RANGE QUADRANT.

Elevate or depress howitzer until its axis is horizontal, correct for difference of level of wheels, set the level scale of the quadrant at 300, then turn the scroll gear handle until the range-level bubble is centered. Now turn the range disk of the quadrant until its zero coincides with the range index. The range disk is held between two friction disks secured by a nut and lock screw and it is only necessary to unscrew these to release the disk and correct its position.

To test the horizontality of the howitzer use the testing level issued for that purpose. This level has two arms perpendicular to each other, and a level vial is inserted in each arm. As the faces of the breech and the muzzle are perpendicular to the axis of the bore, the horizontality of the axis of the bore may be determined by placing one of the arms of the testing level against the face of the breech or muzzle and elevating or depressing the howitzer until the bubble in the level of the other arm is in the center. Then apply the other arm to the same face and the bubble in the first arm should also be in the center of its vial. If not, the testing level requires adjustment.

VERIFICATION OF PARALLELISM OF LINES OF SIGHT AND AXIS OF BORE.

By construction the vertical plane of the lines of sight at zero deflection is distant 14.125 inches from the vertical plane of the axis of the bore; the horizontal plane of the line of sight of the rear sight at zero elevation is distant 5.875 inches from the horizontal plane of the axis of the bore; the corresponding distance for the line of sight of the panoramic sight is 13.182 inches. Therefore, when the carriage is placed with wheels on a level platform, the howitzer with axis of bore horizontal and the sights at zero elevation and deflection, the points in which the lines of sight and the axis of the bore prolonged pierce a distant plane perpendicular to the latter should be located with reference to each other as indicated above, provided the sights are correctly adjusted.

The details of a method for the practical verification of this adjustment are as follows:

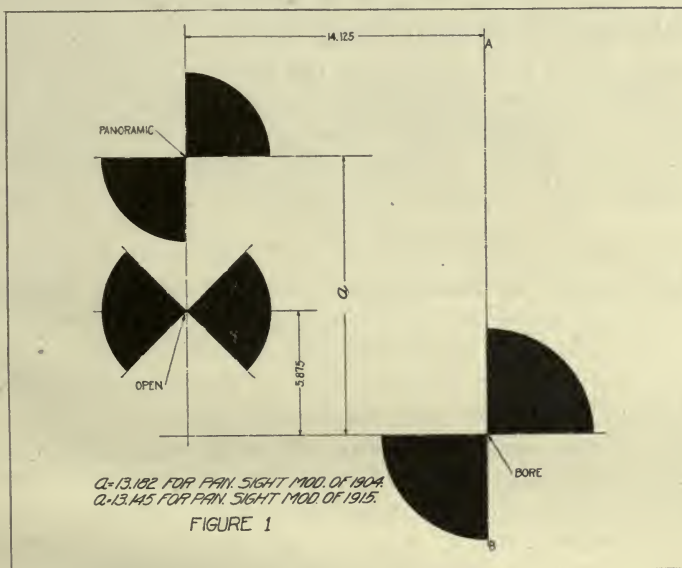
A target of dimensions given in figure 1 is placed in a vertical position perpendicular to the line of sight at a distance of not less than 100 yards from the howitzer (and at such a height that the point "bore" is at the same height as the axis of the bore of the howitzer). The verticality of the target is assured by a plumb line attached at A, coinciding with the vertical line A B.

The carriage is placed with the wheels and trail resting upon solid supports of wood or stone, the surfaces of which have been carefully leveled so as to bring the axle axis horizontal. Now direct the gun so that the prolongation of the axis of the bore, as determined by the bore sights, pierces the target at the proper point; the lines of sight of the open and panoramic sights are then adjusted in direction by the means explained above until they pierce the targets in the points marked, respectively, "open" and "panoramic."

The axis of the bore is determined and prolonged by means of bore sights. In the absence of such means a breech-bore sight may be made from an empty cartridge case from which the primer has been removed; a piece of paper should be pasted over the primer seat and

a pinhole made in its exact center to serve as a peep sight. If the cartridge case does not completely fill the bore, it should be shimmed all around with tissue paper until it does so. For a muzzle-bore sight use should be made of the traces of the horizontal and vertical planes containing the axis of the bore, which are marked on the muzzle of the howitzer. Fine threads or hairs stretched across the muzzle to coincide with these lines form a good bore sight, and the ends of such threads may be conveniently fastened to a cloth strap buckled around the muzzle of the howitzer.

In the field, where from lack of time or proper facilities the method just given can not be followed, the adjustment of the sights may be verified by bringing the lines of sight at zero elevation and deflection



to bear upon some sharply defined point of a distant object. At such a range (for instance, 2,000 yards or more) the parallax may be neglected, and if the sights are correctly adjusted the lines of sight and the prolongation of the axis of the bore will sensibly pass through the selected aiming point.

The adjustment of the sights is of such importance and should be verified so frequently that battery commanders will find it advantageous to make permanent arrangements for such verification. The leveled supports constituting the carriage emplacement should preferably be of stone. The site of the target (fig. 1) should be prepared, and the exact locations of the target and horizontal reference points permanently marked. If these arrangements are properly made, subsequent verifications of sights will become a simple matter.

ADDITIONAL TESTS.

After the sights are adjusted they should be subjected to the following tests to insure their accuracy at extremes of elevation and azimuth:

(a) With carriage level and howitzer and sights at zero elevation and deflection the lines of sight and axis of bore prolonged pierce the target (fig. 1) in the proper points.

(b) The howitzer is then moved to its maximum elevation; as the sight elevation is altered the lines of sight should follow the vertical lines through the same points of the target (fig. 1).

(c) With conditions as in (a) the howitzer is moved upon the carriage to its extreme positions in azimuth; as the sight deflections are now altered the lines of sight should follow the horizontal lines through the same points on the target (fig. 1).

By construction and assemblage the sights, if correctly adjusted, should fulfill the above conditions with substantial accuracy. If error be noted, a report of the facts of the case, with the cause, if known, should be made to the ordnance officer charged with the repair of the material for his information and action.

SPARE SIGHTS AND QUADRANT.

To each battery is issued one set of spare sights, consisting of one front sight holder and sleeve, complete; one cross wire holder bracket, complete; one sight bar, sight shank, complete; and one panoramic sight. These parts are carried in a special packing chest in the battery wagon.

One set of bore sights (consisting of one breech and one muzzle bore sight) and one testing level for use in adjusting sights, etc., and a spare quadrant, complete, are also issued to each battery.

ADJUSTING INSTRUMENTS.

A complete detailed description of the method of disassembling and adjusting the different instruments is given in Ordnance Office Pamphlet No. 1795, Instructions for the Care, Preservation, Repair, and Adjustment of Instruments for the Fire-Control Systems for Coast and Field Artillery. Attention is invited to General Orders No. 47, War Department, March 24, 1905, with reference to the care and repair of panoramic sights. No disassembling of instruments except as prescribed herein will be permitted. The disassembling of telescopic instruments allowed herein must be done only in the presence of a commissioned officer. Disassembling as permitted in pamphlet 1795 must be done only by officers or employees of the Ordnance Department.

GENERAL INFORMATION.

PAINTING ARTILLERY MATÉRIEL.

The paint issued for this purpose is of olive-drab color put up in 5-pound cans ready for use and is applied to both wood and metal parts. If the paint is too thick, turpentine should be used as a thinner but not to greater extent than 2 per cent by volume.

All steel and iron nonbearing surfaces should be painted. Wearing and bearing surfaces, teeth of gear wheels, elevating worms, piston rods, cylinders, counter-recoil springs, and interior of cradle should not be painted.

All parts to be painted should be free from dirt or grease. They may be washed in a liquid made by dissolving one-half pound sal soda in 8 quarts of warm water, then rinsed in clean water, and wiped thoroughly dry.

Where the matériel is in fair condition and only marred in spots, the marred places should be primed with olive-drab paint, second coat, and permitted to dry. Then the whole surface should be sandpapered with No. 1½ sandpaper and a coat of paint applied and allowed to dry thoroughly before use.

Where the matériel is in bad condition all parts should be thoroughly sandpapered with No. 2½ sandpaper, be given a coat of paint, and be permitted to dry for at least 24 hours; then sandpapered with No. 00 sandpaper, apply a finishing coat, and permit the parts to dry thoroughly before use.

In general, two coats of paint per year will be sufficient to keep the matériel in good condition. After repeated painting the paint may become so thick as to scale off in places or give an unsightly appearance. It may then be removed for repainting, as follows:

Dissolve 1 pound of concentrated lye, powdered form, in 6 pints of hot water, and slake in enough lime to give the solution the consistency of paint. Use the solution freshly mixed and apply to the parts where paint is to be removed with a brush or with waste tied to the end of a stick. When the solution begins to dry on the surface use a scraper to remove the old paint, and complete the cleaning of the surface with cloth and water. If one application is not sufficient to loosen the paint, apply a second coat. Before painting wash the surface with sal soda water, rinse with clean water, and then wipe thoroughly as described above.

Articles which can be easily cleaned and repainted may be immersed in the solution. *It is forbidden to immerse articles which can not be entirely repainted;* for example, ammunition chests, the joints, and some parts of the interior of which it would be impracticable to repaint.

For the service, cleaning, and preservation of this matériel the Ordnance Department issues hydroline oil, lubricating oil, clock oil, sperm oil, coal oil, neat's-foot oil, and light slushing oil. Each of these oils is suited for the particular purpose for which it is issued, as stated below, and care should be taken that it is not used for other purposes.

The hydroline oil is for use in the recoil cylinders of the carriages and for no other purpose.

The lubricating oil will be used exclusively in all oil holes of the matériel, and in lubricating such parts as wheels and axles, gun and cradle slides, pintle socket, elevating and traversing mechanisms, exterior of cylinders, brake bearings, hinges, different surfaces of breechblocks, threads of breech recess, etc.

Clock oil should be used on the spindle and all bearings of the battery commander's telescope, bearings of the panoramic sight, range quadrant, and fuze setters, and on the observation telescope, field artillery plotter, sextant telemeter, and worms of the rear sight. In all cases clock oil should only be used when the instruments mentioned are disassembled for cleaning. When used it should be applied by dropping from the end of the dropper attached to the end of the cork.

The sperm oil is a lighter lubricant than the lubricating oil and may be used on the gears of sights, fuze setters, range quadrants, parts of pistols, etc.; lubricating oil may also be used on such parts.

Coal oil is used by the Ordnance Department for cleaning purposes. In the field it may be used for lanterns. Coal oil for general illuminating purposes is furnished by the Quartermaster's Department.

Neat's-foot oil is used for the care and preservation of all leather equipment.

Light slushing oil is prescribed for use in the protection and preservation of all bright or unpainted surfaces of steel or iron on all parts of the equipment when the matériel is to remain unused for an appreciable length of time. Its use as a lubricant for mobile artillery is forbidden.

Before applying the slushing oil to any surface, the part should be thoroughly cleaned, so as to be free from rust, water, coal oil, lubricating oil, etc., as their presence will cause rusting under the slushing oil. The slushing oil should then be applied in a *thin, uniform coat*, since this is ALL that is necessary to give good protection.

Except in very cold weather it can be applied by using a paint brush as when painting; in cold weather it should be applied by stippling—that is, lightly tapping the surface with the end of the sash tool held with bristles perpendicular to the surface to be cov-

ered. It can be applied to the bores of howitzers by the slush brush issued for the purpose. In cold weather it should be warmed before use for coating the bores of howitzers.

It may be readily removed by the use of burlap or waste dipped in coal oil.

REPAIRS FOR FIELD ARTILLERY MATÉRIEL ISSUED TO THE UNITED STATES ARMY AND THE ORGANIZED MILITIA.

Instructions relative to making repairs to field batteries and furnishing ordnance stores and supplies for them will be found in the general orders issued by the War Department from time to time.

Instructions in reference to the care, use, and repair of delicate instruments, such as sights, telescopes, and range finders, will be found in General Orders, No. 47, War Department, Washington, March 24, 1905, and in O. O. pamphlet, Form No. 1795.

INSTRUCTIONS FOR RIVETING.

Whenever a rivet is broken, loose, or needs replacing for any reason the rivets should be heated to a light yellow (just below white) color. They may be heated in the forges furnished with the battery equipment or in a permanent blacksmith's forge. While heating keep the rivets covered with coals in order to prevent scaling. Rivets one-fourth inch and less in diameter may be driven cold when it is impracticable to heat them.

Do not attempt to drive rivets greater than one-fourth inch in diameter when cold. Do not overheat or burn the rivets. Remove all scale from rivets after heating and before driving. Drive the rivets home with a hammer before attempting to form the head. Hold rivets solidly in place with a sledge, crowbar, and fulcrum, railroad iron, or similar heavy piece of steel. Partially form the head with the face and peen end of a hammer. When the head is practically formed by this operation use a rivet set for final forming of the head. The rivet set is only for this final operation. Loose rivets will result, if they are not peened down with a hammer before the rivet set is used. The rivets must be held solidly in place while the riveting is being done, otherwise loose rivets result.

Before starting to heat the rivets the pieces to be riveted should be carefully fitted and bolted together. If the holes in the two pieces are not in perfect alignment, the cause should be determined and rectified instead of attempting to drift the pieces into alignment. If necessary for perfect alignment a slight amount of reaming or filing will be permitted. In no case should a rivet hole be reamed larger than about one sixty-fourth inch in excess of the diameter of the rivet. On account of inaccessibility, it is sometimes difficult to in-

sert a rivet. In such cases it may be inserted with a twisted stiff wire or with a small stick split at the end to hold the rivet. Arrangements must be made beforehand to back up or hold the rivet in place the instant it is located, in order that it may not have cooled too much for proper riveting. Hot riveting is preferable to cold riveting, as the head is more easily formed when hot and the contraction of the rivet in cooling gives a tighter fit.

SUGGESTIONS FOR CARE AND MAINTENANCE OF MATÉRIEL.

Various suggestions in reference to the care of this matériel and hints regarding things to be done or to be avoided are scattered throughout the text of this handbook; some of the more important are here condensed for more convenient reference. Careful compliance with these suggestions will avoid delay and possibly injury to personnel or matériel.

The breechblock should not be opened for at least one minute after a misfire.

All work upon recoil cylinders, sights, and other optical equipment should be done in the presence of a commissioned officer.

The recoil cylinder should never be clamped in a vise, but when necessary to hold it from turning, a spanner applied to front end of cylinder should be used.

Never remove the cylinder-retaining ring when the piece is at an elevation.

Never loosen the swing bolts on the cradle head holding the spring retainer unless the spring compressor is properly assembled to the carriage or the cylinder retaining ring in place.

Remove locking screw before trying to unscrew cylinder retaining ring.

Do not fail to unscrew gun-lug plug partly before attempting to remove the cylinder.

See that proper kind of oil is used in cylinders and for lubrication.

Strain the oil used in filling the cylinders through a fine, clean cloth, and be sure that the receptacles used in handling the oil are clean.

Take every precaution to keep the interior of the cylinders clean and to prevent the entrance of foreign particles.

In assembling the gland, be sure that at least $4\frac{1}{2}$ threads of the gland are engaged with the threads of the stuffing box.

Lash parts with copper wire to prevent unscrewing.

Before firing, inspect to insure that cylinders are properly closed and that the cylinder retaining ring and the piston-rod nut are in place.

Before retracting, see that the retracting eye is securely screwed in the end of the counter recoil buffer.

After filling the cylinder with oil, make sure that the filling plug, the vent plug, the gun-lug plug, and filling and drain plugs are screwed in place.

In assembling the springs, take care that the outer spring column does not catch on the cradle or the inner spring column on the stirrup.

If time permits, oil slides before firing.

If the howitzer fails to return fully into battery, except when caused by expansion of oil, it is probably due (1) to dirt on slides and guides or burrs on these parts; (2) to cutting of sliding surfaces on account of dirt and lack of oil; (3) to gland being screwed up too tightly; (4) to dirt or foreign particles in the cylinder, and especially in the counter-recoil buffer recess; (5) to weak or broken springs; (6) rear cradle head bulged. Ninety per cent of such cases will be found due to (1), (2), or (3).

When a misfire occurs it may be due to improper assembling of the breechblock or the firing device. The assembling arrows on block carrier and operating lever should be opposite each other; in this position the operating lever is about perpendicular to the face of the block when the lever is swung open and the block has rotated to the position of leaving the breech. A check on the improper assembling of the breechblock may be made by removing the firing lock case and ascertaining, when the lever is swung closed, whether the hole for the firing pin in the bushing of the block at the front is masked, or is not concentric with the hole in the block carrier so as to prevent the motion of the firing pin forward; also operate the firing handle with the block closed to determine if the firing shaft trips before the trigger fires. When breech mechanisms of different howitzers are interchanged, this last irregularity may occur.

At all times, except when used for firing, the rocker should be disengaged from the howitzer.

By means of the traveling lock, secure the howitzer to the trail at drill and in traveling to avoid unnecessary strain upon the elevating mechanism.

The length of the recoil of the howitzer during firing should be carefully observed. The approximate recoil that should be obtained for different elevations is as follows:

	Inches.		Inches.
5 degrees depression.....	40	22 degrees elevation.....	30
0 degrees 30 minutes depression.....	40	26 degrees 30 minutes elevation.....	28
degrees elevation.....	40	31 degrees elevation.....	26
8 degrees 30 minutes elevation.....	36	35 degrees 30 minutes elevation.....	24
13 degrees elevation.....	32	40 degrees elevation.....	22
17 degrees 30 minutes elevation.....	30		

If the variation from these recoils differs by more than 5 per cent over or 10 per cent short, it should be investigated and the cause for this variation ascertained and remedied.

For satisfactory action of the recoil-controlling parts it is necessary that the cylinder be filled with oil in the exact method previously given and that the parts be kept scrupulously clean. For that purpose the ports in the liner and valve should be carefully inspected before assembling to see that no foreign particles have collected in them.

In assembling the valve-turning mechanism, the assembling marks on the valve-turning pinion and the valve-turning gear should coincide.

The top carriage cover should be assembled whenever time permits before taking the carriage on the road. The elevating worm mechanism must at all times be kept thoroughly clean, as dust and dirt on it will interfere with its operation and may prevent its being used at all.

Keep hub bolts and hub bands properly tightened.

To tighten hub bands, screw them as tightly as possible with the wrench and then force them farther by striking the end of the wrench with a hammer.

Tires on wheels should be reset as soon as the wheels have lost their initial dish given by shrinkage. In order to determine when this dish is lost without waiting for the felloe and spokes to actually become loose, the following method should be used:

Place a straightedge across the wheel, resting on the felloe and passing near the hub flange. Measure the distance from the straight-edge to a spoke near the felloe and one near the hub box. If the difference in these two distances is less than three-sixteenths of an inch the tire should be reset.

Cold-set tires are much inferior to hot-set tires in that the dish given by the setting of the tire is lost much more rapidly when cold set. Cold setting should therefore be resorted to only when it is impracticable to have the tires hot set.

Do not permit brake levers to be released by a kick or a blow.

Prevent possible injury to cannoneers by causing them to stand clear of the counter-recoil spring column in assembling or dismounting.

In moving the howitzer on or off the cradle, provide ample support for the breech end, so that the howitzer clips are in prolongation of the cradle guides; if this is not done, the cradle guides may be ruined.

Do not strike any metal part directly with a hammer; interpose a buffer of wood or copper.

Frequently verify the adjustment of sights.

Require special care in handling sights.

Be sure that the range strip of the rear sight shank, range ring of hand fuze setter, and range scales of the range quadrant are graduated for the particular type of ammunition used by the battery.

Do not unnecessarily expose ammunition to the sun or load it into a warm howitzer before time for firing; if this is done, erratic shooting may result.

Battery commanders should frequently make a detailed inspection of all the vehicles in the battery to see if any parts of them are broken and any nuts, screws, split pins, etc., missing. If any such defects are found, they should immediately take steps to replace broken or missing parts. This is of the utmost importance, and compliance with these instructions will do much toward prolonging the life of the vehicles.

It has been found that the apron hinges occasionally become broken, and that the apron-hinge pins are frequently lost. Whenever this happens the hinges or hinge pins should be immediately replaced, for if this is not done the apron, which is a very expensive piece, is apt to become cracked or broken.

Whenever the lunettes become loosened the lunette nuts should at once be tightened up.

All wheels and pintle bearings should be frequently oiled.

All nuts are secured by split pins, which should be replaced and properly opened when nuts are screwed home.

All working and bearing surfaces of the carriage require oiling; those not directly accessible for this purpose are provided with oil holes closed by spring covers or handy oilers.

See that fuzes are set at safety for transport.

Use the large primer-inserting press for inserting primers in cartridge cases and the decapping tools provided for removing old primers.

In assembling the cylinder in the cradle, place the springs which are bent most out of shape on the stirrup and cylinder.

In all requisitions and correspondence the correct name of the part referred to (if known) should be given. If the name of the part is not known, submit a sketch showing the location, shape, material, etc., sufficient to establish definitely the identity of the parts in question.

The use of the word "complete" in requisitions to signify a combination of parts sometimes leads to misunderstanding of the exact parts wanted. The tables of nomenclature of parts have been arranged to show the parts included under the terms "one trail, complete; one wheel, complete," etc., and should be carefully studied

before requisitions are made out, to insure that all the parts wanted are included and duplications avoided.

Smokeless powder must not be used for blank charges.

SUPPLIES IN GENERAL.

All bits, both curb and snaffle, are made of nickel steel, a practically noncorrosive metal.

The olive-drab saddle blanket is regulation for all arms of the service.

Arm racks for automatic pistols are issued for use of Field Artillery in such number as may be required to hold the pistols on hand in the battery. Each pistol arm rack holds 80 pistols.

Lanyards with metal snaps are issued with pistols when called for.

Such articles as may be needed for training the horse—the cavesson, longing rein, running rein, etc.—may be readily made up by the battery saddler from supplies furnished by the Ordnance Department.

For the training of enlisted men leather heads and wooden stands for supporting them will be needed. The saddler and the wheelwright or carpenter will be able to supply these by means of the tools in the forge limber and battery wagon.

A reloading and cleaning outfit for 3.8-inch howitzers for removing fired primers from and cleaning cartridge cases and for reloading blank ammunition is furnished to each battery.

METHOD OF LOADING ONE 3.8-INCH HOWITZER BATTERY FOR TRANSPORTATION BY RAIL.

The flat cars usually obtained from railroad companies vary in length from 34 to 44 feet. Cars longer than 42 feet are unusual.

In loading a battery on cars during service operations it is very desirable to keep complete howitzer sections together as much as possible. Pursuing this idea, a 3.8-inch howitzer battery may be loaded as follows, when cars at least 34 feet long are obtained:

Four cars, each to contain:

One 3.8-inch howitzer and carriage.

Two 3.8-inch howitzer caissons.

Three 3.8-inch howitzer limbers.

The vehicles on these cars should be arranged in the following order from one end to the other: Two caissons, one howitzer and carriage, three howitzer limbers. The lunettes of the caissons and carriage and the pole of the first limber should all point in the same direction and away from the end of the car at which the first caisson is loaded; the poles of the other two limbers should point in the opposite direction. One vehicle is run over the pole or trail of another until the

tires of the wheels of two vehicles touch, provided no other parts of the vehicles come in contact.

One car to contain:

- One battery wagon.
- One forge limber.
- Two 3.8-inch howitzer limbers.
- Two 3.8-inch howitzer caissons.

One car to contain:

- One store wagon.
- One store limber.
- Two 3.8-inch howitzer limbers.
- Two 3.8-inch howitzer caissons.

This car will be only about three-quarters filled if a 34-foot car is procured. The additional space may be utilized as the battery commander sees fit.

If cars less than 34 feet long are obtained, one limber or one caisson will have to be omitted. If cars 44 feet long are obtained, one additional limber or caisson can be loaded on each.

In loading the cars, if there is any permanent loading platform along the railroad tracks in the vicinity, the vehicles should be run onto these platforms and loaded from them. If there is no permanent platform in the vicinity, it will be necessary to build a temporary ramp. This should be built at the end of the cars. When loading vehicles from a permanent platform on the side of the cars it may be necessary, if short cars are obtained, to remove the pole of the last limber placed on the car in order to get it onto the car. The pole should, however, be replaced in its socket as soon as the vehicle is placed in position.

When loading the cars, care must be exercised to load them so that there can be no movement of the vehicles on the cars longitudinally, transversely, or vertically. All wheels, and trails of carriages, poles of limbers, lunettes of caissons and wagons must be secured to the bottom of the car. The vehicles are secured as follows:

2 by 4 inch timbers nailed to the floor of the cars on both sides of all the wheels hold the wheels securely against transverse motion.

2 by 4 inch chocks nailed to the 2 by 4 inch pieces which lie along the sides of the wheels hold the wheels against longitudinal motion on the cars.

2 by 4 inch timbers, placed over the felloes, between the two lowest spokes and bolted to the floor of the car through the pieces at the sides of the wheels, with two $\frac{1}{2}$ -inch bolts, hold the wheels against vertical motion. The bolts should preferably be bolted through these braces on the outside of the wheels. If bolts for bolting these 2 by 4 inch cross pieces can not be obtained, the cross pieces should

be nailed down with 7 or 8 inch spikes. The poles and lunettes should be secured to the floor by nailing one 2 by 4 inch block on both sides of each and one 2 by 4 inch piece across the top near the end of the poles or lunettes.

The trails should be secured to the floor by nailing 2 by 4 inch blocks as follows:

- 1 on each side of the trail,
- 1 at the end of the trail in prolongation of the axis, and
- 1 across the top near the end.

All of the lumber used on the cars is 2 by 4 inch stock. To load a 3.8-inch howitzer battery will require 1,200 linear feet of 2 by 4 inch lumber.

For carrying all harness and all accessories of the vehicles which are not carried in compartments of these vehicles or rigidly attached to them, one box car should be obtained. The material in this box car should be packed in boxes if on hand. In case no box car can be obtained, all of the harness, etc., should be packed in boxes and placed on the flat cars near the vehicles. These boxes must be securely fastened to the floor to prevent them from falling off of the cars or from striking and injuring the vehicles.

If it is necessary to raise a complete vehicle from the ground, the main part which supports the weight should be the axle. A manila rope should be passed around the outer end of each wheel hub in the annular space between the hub ring and the hub band and a balancing sling secured at the pole or lunette. These slings should be securely lashed to their respective parts with additional smaller rope, if necessary, to prevent the sling slipping or being knocked off.

EQUIPMENT.

The following table shows the total equipment of one 3.8-inch howitzer battery on war footing. A place is designated for most of the articles, but the battery commander may use his discretion as to the disposition of many articles for which no particular fitting or receptacle is provided.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY.

War footing (4 how- itzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
4	Howitzers and howitzer carriages.....		IV	3
12	Caissons.....			
16	Limbers.....			
1	Battery wagon.....		IV	9
1	Forge limber.....			
1	Store wagon.....			
1	Store limber.....			
TOOLS AND ACCESSORIES FOR HOWITZ- ERS AND CARRIAGES.				
8	Axle seat cushions.....	On axle seat.....	IV	3
4	Breech covers.....	On howitzer.....		
8	Cases for hand fuze setters.....	On trail box.....		
4	Covers for front sight and sight bars.....	On front sight.....		
4	Covers for quadrant bars.....	On quadrant bar.....		
4	Covers for sight shanks.....	On sight shank.....		
8	Dust guards for 56-inch wheels.....	On wheel.....		
8	Hand fuze setters.....	In case.....		
4	Horizontal oilers, model of 1913.....	In oil can box.....		
8	Lanyards.....	In trail box.....		
4	Leather pouches for spare parts.....	do.....		
4	Lock washer holders.....	do.....		
4	Muzzle covers.....	On howitzer.....		
4	Oil can boxes.....	In trail box.....		
4	Screw driver, 3-inch blades.....	do.....		
4	Sponge and staffs.....	On trail.....		
4	Sponge covers.....	On sponge.....		
4	Tool kits containing.....	In trail box.....		
	1 cold chisel, 0.75, 8 inches long.....	In tool kit.....		
	1 cross peen hammer.....	do.....		
	1 bronze drift, large.....	do.....		
	1 bronze drift, small.....	do.....		
	1 file, 8-inch hand, smooth.....	do.....		
	1 file, 3-square, dead smooth.....	do.....		
	1 pliers, wire cutting.....	do.....		
	1 punch, small.....	do.....		
	1 range quadrant wrench.....	do.....		
	1 screw driver, 10 inch.....	do.....		
	1 screw slot wrench and blade.....	do.....		
	1 screw wrench, 8-inch.....	do.....		
	1 wrench, 0.375 and 0.5.....	do.....		
	1 wrench, 0.625 and 0.75.....	do.....		
4	Top carriage covers.....	About top carriage.....	IV	3
4	Valve retainer tools.....	In trail box.....		
4	Wrenches, 0.5.....	do.....		
4	Wrenches, socket.....	do.....		
4	Wrenches, spanner, wheel and cylinder.....	do.....		
4	Wrenches, spanner, cylinder head and gland.....	do.....		
4	Wrenches, 1.25 socket, and 1 and 0.75.....	do.....		
4	3-pound spool, No. 20, annealed, bare copper wire.....	do.....		

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	SPARE PARTS FOR HOWITZERS AND CARRIAGES.			
	<i>For howitzers, models of 1908 and 1908 MI.</i>			
1	Breech mechanism, complete.	In chest in battery wagon.		
4	Block latches.	In leather pouches for spare parts.		
4	Block latch springs.	do.		
4	Firing pins.	do.		
4	Firing pin springs.	do.		
4	Firing spring sleeves.	do.		
2	Handy oilers.	do.		
4	Hinge pin catches.	do.		
4	Lever latch pivots.	do.		
4	Lever latch springs.	do.		
4	Locking bolt, nuts, and pins.	do.		
4	Locking bolt springs.	do.		
8	Lever pivot detents.	do.		
4	Sears.	do.		
4	Trigger forks.	do.		
8	Trigger shaft detents.	do.		
	<i>For hand fuze setters, model of 1913.</i>			
6	Corrector scale screws.	do.		
12	Guide plate screws.	do.		
4	Index plungers.	do.		
4	Index springs.	do.		
8	Index bar screws.	do.		
4	Oil-hole screws.	do.		
4	Range indexes.	do.		
16	Range ring screws.	do.		
3	Stop-pin screws.	do.		
	<i>For carriages.</i>			
1	Apron latch complete, consisting of—			
1	Body.	In store wagon.		
1	Handle.	do.		
1	Handle pin.	do.		
1	Plunger.	do.		
2	Springs.	In chest for miscellaneous spare parts.	IV	3
1	Split pin.	do.		
1	Apron-latch washer.	do.		
6	Screws for handwheel shaft bearing.	do.		
2	Bolts for handwheel shaft bracket.	do.		
8	Screws for elevating worm bearing.	do.		
1	Brake lever, with catch.	In store wagon.		
4	Brake shoes.	do.		
8	Brake-shoe tap bolts.	In chest for miscellaneous spare parts.		
1	Brake-segment rack, with rivets.	do.		
2	Brake-rod pins.	do.		
1	Brake-rod spring.	do.		
2	Counter-recoil springs, outer.	In store wagon.		
2	Counter-recoil springs, inner.	do.		
5	Cradle clip pins, with split pins.	In chest for miscellaneous spare parts.		
1	Gland lock, with split pin.	do.		
2	Drain plugs (cylinder).	do.		
16	Filister head steel screws, with nuts.	do.		
1	Firing mechanism, complete, consisting of—			
1	Adjusting screw.	do.		
2	Bracket studs, with nuts.	do.		
1	Firing handle.	do.		
1	Firing-handle bracket.	do.		
1	Firing-handle hub.	do.		
1	Firing-handle pin.	do.		
1	Firing-handle plunger.	do.		
3	Firing-handle spring.	do.		
2	Firing links.	do.		
2	Firing-link pins.	do.		
1	Firing pallet.	do.		
1	Firing-pallet collar.	do.		
1	Firing-pallet collar pin.	do.		
1	Firing shaft.	do.		
1	Handle return spring.	do.		
1	Shaft return spring.	do.		

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 cais- sons).	Article.	Where carried.	Property classification.	
			Class.	Sec- tion.
	SPARE PARTS FOR HOWITZERS AND CARRIAGES—continued.			
	<i>For carriages—Continued.</i>			
	Firing mechanism, complete, consist- ing of—Continued.			
1	Shaft trip collar.....	In chest for miscellaneous spare parts..		
1	Trip-collar pin.....	..do.		
1	Trip latch.....	..do.		
1	Trip-latch pin.....	..do.		
1	Trip-latch plunger.....	..do.		
1	Trip-latch spring.....	..do.		
2	Filling plugs.....	..do.		
20	Garlock's waterproof packing, $\frac{1}{4}$ -inch rings.	5 in each pouch for spare parts.....		
2	Handspikes, complete, each.....	In store wagon.....		
	Consisting of—			
	2 handspike bodies, with riv- ets, and washers.	..do.		
	1 handspike bolt, with nut....	In chest for miscellaneous spare parts..		
	1 handspike rivet.....	..do.		
	1 handspike web.....	..do.		
	1 lower band, with pin.....	..do.		
	1 tip, with pins.....	..do.		
	1 middle band, with pin.....	..do.		
24	Handy oilers, 0.312 ($\frac{1}{8}$) inch.....	In chest for miscellaneous spare parts..		
10	Handy oilers, 0.375-inch.....	..do.		
1	Lunette, with nut.....	In store wagon.....		
1	Quick-return pawls, complete, con- sisting of—			
2	Bushings.....	In chest for miscellaneous spare parts..		
1	Fulcrum pin.....	..do.		
1	Latch.....	..do.		
1	Link.....	..do.		
2	Link pins.....	..do.		
1	Pawl, right.....	..do.		
1	Pawl, left.....	..do.		
1	Pawl handle.....	..do.		
2	Pawl springs.....	..do.		
1	Pawl shaft, with nut.....	..do.		
2	Plunger rods.....	..do.		
2	Plunger-rod pins.....	..do.		
50	Rivets, assorted.....	..do.		
1	Spade edge.....	..do.		
5	Spade edge rivets.....	..do.		
1	Sponge and staff, complete, consist- ing of—			
1	End staff.....	In store wagon.....		
1	Rammer head.....	..do.		
4	Rammer head screws.....	..do.		
1	Sponge.....	..do.		
1	Sponge collar.....	..do.		
1	Taper pin.....	..do.		
1	Sponge head.....	..do.		
1	Staff coupling (female).....	..do.		
1	Sponge tube.....	..do.		
2	Sponge-tube support.....	..do.		
1	Sponge cover.....	In store wagon on sponge.....		
6	Spring covers, No. 2, with screw.....	In chest for miscellaneous spare parts..		
2	Spring covers, No. 3.....	..do.		
4	Traversing bearing-cap screws.....	..do.		
2	Traversing bearing caps.....	..do.		
1	Traversing nut.....	..do.		
1	Traversing pivot, with nut.....	..do.		
2	Trunnion cap swing bolts, with nuts..	..do.		
2	Trunnion cap pins, with split pin.....	..do.		
1	Valve-turning gear collar.....	..do.		
1	Valve-turning gear connecting rod and nut.	..do.		
4	Valve-turning gears connecting rod pins	..do.		
2	Vent plugs and gaskets.....	..do.		
2	Wheels, complete.....	In fastenings on store wagon.....		
2	Wheel fastenings, complete.....	In store wagon in spare wheel hub caps.		
2	Hub liners.....	In chest for miscellaneous spare parts..		
1	Lock washer.....	..do.		

IV

3

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 howitzers, 12 calcs- sons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	SPARE PARTS FOR HOWITZERS AND CARRIAGES—continued.			
	<i>For carriages—Continued.</i>			
	<i>Crown nuts (special).</i>			
4	0.25 x 20 threads.....	In chest for miscellaneous spare parts..		
16	0.375 x 16 threads.....	do.....		
8	0.5 x 13 threads.....	do.....		
2	0.625 x 11 threads.....	do.....		
4	0.625 x 11 threads.....	do.....		
4	0.75 x 16 threads.....	do.....		
8	0.875 x 9 threads.....	do.....		
2	0.875 x 12 threads.....	do.....		
4	1 x 12 threads.....	do.....		
2	1.25 x 7 threads.....	do.....		
	<i>Crown nuts (standard).</i>			
14	0.25 x 20 threads.....	do.....		
8	0.312 ($\frac{5}{16}$) x 18 threads.....	do.....		
70	0.375 x 16 threads.....	do.....		
16	0.5 x 13 threads.....	do.....		
32	0.625 x 11 threads.....	do.....		
30	0.75 x 10 threads.....	do.....		
	<i>Plain nuts (special).</i>			
2	0.19 x 30 threads.....	do.....		
2	0.242 x 24 threads.....	do.....		
	<i>Rivets (button head).</i>			
4	0.187 ($\frac{3}{16}$) x 1.375 inch.....	do.....		
6	0.25 x 1.125 inch.....	do.....		
25	0.312 ($\frac{5}{16}$) x 1.625 inch.....	do.....		
7	0.375 x 1.25 inch.....	do.....		
2	0.5 x 1.75 inch.....	do.....		
	<i>Rivets (countersunk head, 60°).</i>			
6	0.312 ($\frac{5}{16}$) x 0.75.....	do.....		
	<i>Split pins.</i>			
8	0.046 ($\frac{1}{16}$) x 0.312 ($\frac{1}{8}$) inch.....	In leather pouches for spare parts.....		
3	0.062 ($\frac{1}{16}$) x 0.375 inch.....	do.....		
4	0.062 ($\frac{1}{16}$) x 0.562 ($\frac{1}{8}$) inch.....	do.....		
25	0.062 ($\frac{1}{16}$) x 0.75 inch.....	do.....		
4	0.078 ($\frac{1}{16}$) x 0.437 ($\frac{1}{8}$) inch.....	do.....		
5	0.093 ($\frac{1}{16}$) x 0.5 inch.....	do.....		
15	0.093 ($\frac{1}{16}$) x 0.75 inch.....	do.....		
130	0.093 ($\frac{1}{16}$) x 1 inch.....	do.....		
4	0.125 x 0.75 inch.....	do.....		
10	0.125 x 1 inch.....	do.....		
50	0.125 x 1.25 inch.....	do.....		
10	0.125 x 1.5 inch.....	do.....		
10	0.125 x 1.75 inch.....	do.....		
2	0.156 ($\frac{1}{8}$) x 1 inch.....	do.....		
50	0.156 ($\frac{1}{8}$) x 1.5 inch.....	do.....		
20	0.156 ($\frac{1}{8}$) x 1.75 inch.....	do.....		
20	0.156 ($\frac{1}{8}$) x 2 inch.....	do.....		
2	0.203 ($\frac{1}{4}$) x 1.5 inch.....	do.....		
2	0.203 ($\frac{1}{4}$) x 2 inch.....	do.....		
2	0.203 ($\frac{1}{4}$) x 2.25 inch.....	do.....		
10	0.203 ($\frac{1}{4}$) x 2.5 inch.....	do.....		
4	0.25 x 1.25 inch.....	do.....		
	<i>Taper pins.</i>			
2	0.162 x 1.75 inch.....	do.....		
2	0.135 x 1.562 ($1\frac{1}{16}$) inch.....	do.....		

IV

3

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 howitzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	TOOLS AND ACCESSORIES FOR LIMBERS.			
16	Axes.....	On limber in fastenings.....	IV	3
16	Hatchets.....	do.....		
16	Lanterns.....	In bracket.....		
16	Lantern straps.....	In fasteners.....	IV	9
16	Lantern bracket pads.....	In bracket.....	IV	3
32	Oil cans.....	In limber chests.....	IV	9
16	Paulins.....	On limber chest.....		
16	Pickaxes.....	On limber in fastenings.....		
16	Picket ropes.....	On limber.....		
16	Pole props.....	On limber in fastenings.....		
16	Short-handled shovels.....	do.....		
16	Shot tongs.....	do.....	IV	9
32	Dust guards for 56-inch wheels.....	On wheel.....		
16	Neck yokes, complete.....	On pole.....		
32	Singletrees, complete.....	On doubletree.....		
	Straps.....			
16	Ax.....	In fasteners.....	IV	3
48	Grip.....	do.....		
16	Hatchet handle.....	do.....		
48	Paulin.....	do.....		
16	Pick head.....	do.....		
64	Picket rope.....	do.....		
16	Pole prop.....	do.....		
16	Shot tongs.....	do.....		
16	Shovel handle.....	do.....		
	SPARE PARTS FOR LIMBERS.			
2	Doubletrees.....	In store wagon.....	IV	3
3	Doubletree bolts and nuts.....	In chest for miscellaneous spare parts.....		
2	Doubletree hooks.....	In store wagon.....		
3	Hub liners.....	do.....		
3	Limber prop chain, with handle.....	do.....		
2	Lock bar bearing caps with studs and nuts.....	In chest for miscellaneous spare parts.....		
2	Lock links.....	In store wagon.....		
2	Latch-pin plates.....	do.....		
3	Lock washers.....	In chest for miscellaneous spare parts.....		
1	Lock bar pivot.....	do.....		
2	Neck yokes.....	In store wagon.....		
4	Oil-can nozzles.....	In chest for miscellaneous spare parts.....		
2	Oil cans, tubular.....	In store wagon.....		
1	Picket rope.....	do.....		
2	Padlocks, chains, clevises, and bolt snap.....	In chest for miscellaneous spare parts.....		
1	Pintle, with bearing, complete.....	In store wagon.....		
1	Pintle spring.....	In chest for miscellaneous spare parts.....		
1	Pintle latch.....	In store wagon.....		
2	Pintle latch spring.....	In chest for miscellaneous spare parts.....		
2	Pintle bearing bolts with nuts.....	do.....		
2	Poles, complete.....	Under caisson.....		
2	Pole props.....	In store wagon.....		
1	Shot tong.....	do.....		
4	Singletree.....	do.....		
3	Wheel fastenings, complete.....	In store wagon, in spare hub caps.....		
1	Wing nut pin with nut and washer.....	In chest for miscellaneous spare parts.....		
	TOOLS AND ACCESSORIES FOR CAISSONS.			
12	Long-handled shovels.....	On caisson in fastenings.....	IV	9
12	Paulins.....	On caisson.....		
12	Pick mattocks.....	On caisson in fastenings.....		
12	Spanners.....	do.....		
36	Watering buckets, canvas.....	In bucket holder.....		
12	Wrenches, 0.625 x 0.75.....	On caisson in fastenings.....	IV	3
12	Axes.....	do.....		
12	Shot tongs.....	do.....		
24	Dust guards for 56-inch wheel.....	On wheels.....	IV	

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 cais- sons).	Article.	Where carried.	Property classification.			
			Class.	Section.		
	TOOLS AND ACCESSORIES FOR CAISSONS— continued.					
	Straps:					
12	Ax.....	In fasteners.....	IV	3		
36	Grip.....	do.....				
36	Paulin.....	do.....				
12	Pick mattock.....	do.....				
12	Shot tongs.....	do.....				
12	Shovel handle.....	do.....				
12	Spanner.....	do.....				
12	Wrench.....	do.....				
	SPARE PARTS FOR CAISSONS.					
2	Apron end hinges.....	In store wagon.....			IV	3
4	Apron hinge pins.....	In hinge.....				
1	Apron latch, complete.....	In store wagon.....				
2	Apron latch springs.....	In chest for miscellaneous spare parts..				
2	Apron center hinge.....	In store wagon.....				
2	Brake levers with catches.....	do.....				
12	Brake shoes.....	do.....				
24	Brake shoe tap bolts.....	In chest for miscellaneous spare parts..				
1	Caisson prop, with chain and hook....	In store wagon.....				
1	Caisson prop chain and hook.....	do.....				
3	Hub liners.....	do.....				
2	Lock bar bearing caps with studs and nuts.....	do.....				
2	Locklinks.....	do.....				
2	Latch pin plates.....	do.....				
3	Lock washers.....	do.....				
1	Lunette with nut.....	do.....				
1	Lock-bar pivot.....	In chest for miscellaneous spare parts..				
2	Padlocks, chains, clevises, and bolt snaps.....	do.....				
1	Pintle, with bearing complete.....	In store wagon.....				
1	Pintle spring.....	In chest for miscellaneous spare parts..				
1	Pintle latch.....	In store wagon.....				
2	Pintle latch springs.....	In chest for miscellaneous spare parts..				
2	Pintle bearing bolts with nuts.....	In store wagon.....				
1	Shot tongs.....	do.....				
6	Wheels, complete.....	2 in spare wheel fastening on battery wagon, rest in store.				
3	Wheel fastenings, complete.....	In spare hub caps.....				
1	Wing nut pin with nut and washer....	In chest for miscellaneous spare parts..				
	Split pins.					
5	0.093 ($\frac{1}{16}$) x 0.75 inch.....	In pouches for spare parts.....	IV	3		
45	0.093 ($\frac{1}{16}$) x 0.875 inch.....	do.....				
5	0.125 x 0.75 inch.....	do.....				
10	0.125 x 1 inch.....	do.....				
15	0.125 x 1.25 inch.....	do.....				
100	0.125 x 1.75 inch.....	do.....				
18	0.156 ($\frac{1}{8}$) x 1 inch.....	do.....				
95	0.156 ($\frac{1}{8}$) x 1.5 inch.....	do.....				
7	0.203 ($\frac{1}{4}$) x 2.25 inch.....	do.....				
	TOOLS AND ACCESSORIES FOR BATTERY WAGON.					
1	Carpenters' chest, with tools, set.....	In battery wagon.....	IV	9		
1	Chest for cleaning material and small stores.....	do.....				
1	Chest for spare breech mechanism.....	do.....				
1	Chest for spare sights, containing— 1 bore sight, breech.....	do.....	IV	3		
	1 bore sight, muzzle.....	do.....				
1	Double-tackle block.....	do.....	IV	9		
2	Dust guards.....	On wheels.....	IV	3		
1	Forge coal bag.....	On battery wagon.....	IV	9		
1	Filling funnel, cylinder.....	In battery wagon.....	IV	3		
1	Grindstone with frame, complete.....	do.....	IV	9		
1	Jackscrew.....	do.....	IV	9		
1	Marking outfit for stamping leather..	In cleaning-material and small-stores chest.....	X	5		
1	Marking outfit for stamping metal.....	do.....				
3	Oil cans, 5-gallon.....	In oil-can supports.....				
1	Ordnance Department insignia stencil.	In cleaning-material and small-store chest.....	X	5		

STATEMENT OF TOTAL EQUIPMENT OF ONE .38-INCH HOWITZER BATTERY—Contd.

War footing (4 howitzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	TOOLS AND ACCESSORIES FOR BATTERY WAGON—continued.			
1	Packing chest for supplies (1902 Mi only).	In battery wagon.....	IV	3
1	Packing chest for spare parts (1902 Mi only).	.....do.....		
1	Paulin.....	On battery wagon.....	IV	9
1	Rope for block and tackle.....	In battery wagon.....		
1	Saddler's chest, with tools, set.....	.....do.....	X	9
1	Seal stamp.....	In cleaning-material and small-stores chest.....	X	5
1	Single-tackle block.....	In battery wagon.....	IV	9
2	Spare wheel-hub covers.....	On spare wheels.....	IV	3
2	Spring compressors No. 2.....	.....do.....	X	9
1	Stencil outfit.....	In cleaning-material and small-stores chest.....	X	5
	Straps:			
2	Grip.....	In strap fasteners.....	IV	3
2	Jackscrow.....	.....do.....		
2	Paulin.....	.....do.....	IV	9
1	Testing level and chest.....	In battery wagon.....		
1	Vise.....	Attached to lunette frame.....	X	9
2	Water buckets, galvanized steel.....	In battery wagon.....	IV	9
1	Wrench, grindstone, and recoil-spring assembling.....	.....do.....	IV	3
	TOOLS AND ACCESSORIES FOR STORE WAGON.			
20	Bolos.....	In store wagon.....	VII	5
20	Bolo scabbards.....	.....do.....		
1	Chest for miscellaneous spare parts.....	.....do.....	IV	3
1	Crowbar.....	On store wagon under body.....		
2	Dust guards.....	On wheels.....	IV	9
1	Filling funnel, cylinder.....	In store wagon.....		
3	Oil cans, 5-gallon.....	On store wagon in oil-can supports.....	IV	3
1	Paulin, 12 by 12 feet.....	.....do.....		
6	Pliers, wire-cutting.....	.....do.....	IV	9
1	Slush brush.....	.....do.....	IV	3
	Straps:			
1	Crowbar.....	In strap fasteners.....	IV	3
2	Grip.....	.....do.....		
2	Paulin.....	.....do.....	IV	3
2	Spare wheel-hub covers.....	In store wagon.....		
	TOOLS AND ACCESSORIES FOR FORGE LIMBER.			
1	Ax.....	On limber under chest.....	IV	9
3	Buckets, watering, canvas.....	On limber, in bucket holder.....		
2	Dust guards.....	On wheels.....	IV	3
1	Hatchet.....	In bracket on left of chest.....	IV	9
1	Hub liner driving tool.....	In forge limber.....	IV	3
1	Lantern.....	On limber, in bracket on front of chest.....	IV	9
1	Lantern-bracket pad.....	In lantern bracket.....	IV	3
1	Lantern strap.....	In strap fasteners.....		
1	Neck yoke.....	On pole.....	IV	9
2	Oil cans, tubular.....	On limber, in supports under chest.....		
1	Paulin, 12 by 12 feet.....	On limber chest as cushion.....	IV	9
1	Pick ax.....	On limber foot rest.....		
1	Picket rope.....	On limber, in front of chest.....	IV	9
1	Pole prop.....	On limber, in fastenings under frame.....	IV	3
1	Shovel, short-handled.....	On limber, under chest.....	IV	9
2	Singletrees.....	Attached to doubletree.....	IV	3
	Straps:			
1	Ax.....	In strap fasteners.....	IV	3
3	Grip.....	.....do.....		
1	Hatchet.....	.....do.....	IV	9
4	Limber-blanket, front.....	.....do.....		
4	Limber-blanket, rear.....	.....do.....	IV	3
3	Paulin.....	.....do.....		
1	Pick-handle.....	.....do.....	IV	9
1	Pick-head.....	.....do.....		
4	Picket-rope, upper.....	.....do.....	IV	3
4	Picket-rope, lower.....	.....do.....		
1	Pole-prop.....	.....do.....	IV	9
1	Shovel-handle.....	.....do.....		
1	Sledge.....	In fastener.....	IV	3

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 cals- sons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	TOOLS AND ACCESSORIES FOR STORE LIMBER.			
1	Ax.....	On limber, under chest.....	IV	9
3	Buckets, watering, canvas.....	In bucket holder.....		
1	Cyclometer for 56-inch wheel.....	On axle of limber.....		
2	Dust guards.....	On wheels.....	IV	3
1	Hatchet.....	On limber, in bracket.....	IV	9
1	Lantern.....	On limber, in bracket on chest front.....		
1	Lantern-bracket pad.....	In brackets.....		
1	Lantern strap.....	In strap fasteners.....	IV	3
1	Neck yoke.....	On pole.....		
2	Oil cans, tubular.....	On limber, in supports.....		
1	Paulin, 12 by 12 feet.....	On limber chest as cushion.....	IV	9
1	Pick ax.....	On limber foot rest.....		
1	Picket rope.....	On limber, in front of chest.....		
1	Pole prop.....	In fastening under frame.....	IV	3
1	Shovel, short-handled.....	On limber under chest.....	IV	9
2	Singletrees.....	Attached to doubletrees.....		
	Straps:			
1	Ax.....	In strap fasteners.....	IV	3
3	Grip.....	do.....		
1	Hatchet.....	do.....		
4	Limber blanket, front.....	do.....		
4	Limber blanket, rear.....	do.....		
3	Paulin.....	do.....		
1	Pick-handle.....	do.....		
1	Pick-head.....	do.....		
4	Picket-rope, upper.....	do.....		
4	Picket-rope, lower.....	do.....		
1	Pole-prop.....	do.....		
1	Shovel-handle.....	do.....		
	SPARE PARTS OF ACCESSORIES.			
4	Ax helves.....	In store wagon.....	IV	9
2	Handles, shovel, long.....	do.....		
3	Handles, shovel, short.....	do.....		
4	Handles, hatchet.....	do.....		
4	Handles, pick ax.....	do.....		
3	Padlocks with chains, clevises, and bolt snaps.....	In battery wagon.....		
	SIGHTS AND QUADRANTS.			
4	Sights, complete.....	On carriage.....	IV	3
4	Panoramic sights.....	In case on shield.....		
4	Range quadrants.....	do.....		
4	Teat wrenches (for panoramic sight, model of 1904 only).....	do.....		
	SPARE SIGHTS AND QUADRANTS.			
1	Sight, complete.....	In spare sight chest in battery wagon.....	IV	3
1	Panoramic sight.....	do.....		
1	Range quadrant.....	do.....		
	RANGE-FINDING AND FIRE-CONTROL EQUIPMENT.			
	(Furnished by Ordnance Department.)			
11	Aiming circle.....	On person or in store limber.....	V	1
11	Aiming-circle case.....	do.....		
11	Aiming-circle tripod.....	do.....		
11	Aiming-circle tripod case.....	do.....		
210	Battery commander's rulers, wooden.....	do.....		
1	Battery commander's telescope and mount, model of 1905 or 1915.....	In cases, on the saddle or in store limber.....		
1	Battery commander's telescope case.....	In store limber.....		
	Accessories carried in case—			
	1 camel's-hair brush.....	do.....		
	1 pin wrench.....	do.....		
	1 screw driver.....	do.....		
	1 teat wrench.....	do.....		
1	Battery commander's telescope tripod.....	do.....		
1	Battery commander's telescope tripod case.....	do.....		
2	Chains for time-interval recorders.....	do.....		

1 Will be issued when available.

2 Metal B. C. rulers with cases are no longer part of the equipment. Those on hand may be retained.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 cais- sons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	RANGE-FINDING AND FIRE-CONTROL EQUIPMENT—continued.			
1 1	Field Artillery range finder, 1-meter base.	On wheel horse or on saddle of mount..	V	1
1	Field Artillery range-finder case.....	do.....		
1	Field Artillery range-finder tripod.....	do.....		
1	Field Artillery range-finder tripod case.....	do.....		
5	Flash lights with hoods.....	In store limber.....		
16	Flash lights without hoods.....	do.....		
1	Tape, steel, 100 feet.....	do.....		
2	Time-interval recorders.....	do.....		
	(Furnished by Signal Corps. ²)			
	HARNESS.			
3 37	Harness, lead, sets.....	On horses.....	IV	8
3 19	Harness, wheel, sets.....	do.....		
56	Harness sacks.....	Not carried in field.....		
1	Stirrup, hooded, with guidon socket.....	On saddle.....		
	SPARE PARTS OF HARNESS.			
6	Breast straps.....	In battery wagon.....	IV	8
1	Bridle, Artillery, off.....	do.....		
1	Bridle, Artillery, near.....	do.....		
12	Cinchas, lead.....	do.....		
6	Cinchas, wheel.....	do.....		
4 5	Collar pads, canvas.....	do.....	IX	5
8	Collar straps.....	do.....		
4 20	Curb bits.....	do.....		
4 20	Curb chains, with hooks.....	do.....		
8	Feed bags.....	do.....		
8	Grain bags.....	do.....	IV	8
6	Halter headstalls.....	do.....		
20	Halter tie ropes.....	do.....		
6	Martingales with cincha strap.....	do.....		
4	Mogul springs, 320 pounds.....	do.....		
6	Side straps for breeching.....	do.....	IV	8
4	Steel collars, with 2 hame tugs each.....	do.....		
12	Stirrup straps.....	do.....		
8	Traces, lead, with chain.....	do.....		
4	Traces, wheel.....	do.....		
4	Whips, Artillery.....	do.....		
	SPARE PARTS OF COLLARS.			
6	Bolts for bottom of collar.....	In miscellaneous spare parts chest, store wagon.....	IV	8
6	Bolts for extension.....	do.....		
6	Bolts for top connection.....	do.....		
6	Bolts for trace plate.....	do.....		
2	Buckle latches.....	do.....		
6	Buckle springs.....	do.....		
4	Draft springs.....	Carried loose.....		
6	Pad bolts.....	In miscellaneous spare parts chest, store wagon.....		
6	Pad hooks, with collar back strap connection.....	Carried loose.....		
6	Nuts for bottom bolt.....	In miscellaneous spare parts chest, store wagon.....		
6	Nuts for extension bolt.....	do.....		
6	Nuts for top connection bolt.....	do.....		
6	Nuts for pad bolt.....	do.....		
6	Nuts for trace plate bolt.....	do.....		
2	Trace plate and loops.....	do.....		
6	Washers for trace plate bolt.....	do.....		
	INSTRUCTION EQUIPMENT.			
1	Sectionalized shell.....	Not carried in field.....	V	4
1	Sectionalized shrapnel.....	do.....		

¹ Field Artillery range finders will be issued as soon as a supply is available. When issued, the sextant telemeter now on hand in some of the organizations will be turned in.

² For list of these parts see Unit Accountability Equipment Manual.

³ One set is spare.

⁴ Not part of harness.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 howitzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	MISCELLANEOUS EQUIPMENT.			
75	Cartridge cases, saluting.....	In chest for reloading and cleaning outfit in store wagon.	V	5
8	Cartridge cases, for drill.....			
8	Drill projectiles.....			
1	Reloading and cleaning outfit consisting of—			
	1 bushing.....			
	1 cleaning brush (16.75 inches long).....	do.	V	5
	1 case holder.....	do.		
	1 case-holder stand.....	do.		
	1 decapping tool (17.9 inches long).....	do.		
	1 hammer.....	do.		
	1 primer inserting press, large.....	do.		
	1 saluting powder measure.....	do.		
	1 storage chest.....	do.		
1	Pistol-cleaning kit.....	Where convenient.....	X	9
2	Arm racks for automatic pistols. (For targets, see O. O. Pamphlet No. 1994.)		X	1
	AMMUNITION.			
672	Shrapnel, H. E. rounds, or.....	In ammunition chests.....	V	4
504	Shrapnel, common rounds, and.....	do.		
168	Shell, rounds.....	do.		
	PERSONAL EQUIPMENT.			
	The equipment of the enlisted men of Field Artillery is as follows:			
	(a) For each enlisted man—			
1	Can, bacon.....	Carried on man.....	IX	1
1	Canteen, model of 1910.....	do.		
1	Canteen cover, dismounted.....	do.	VII	2
21	Cartridges, ball, pistol, or 20 cartridges, ball, revolver.....	do.		
1	Cup, model of 1910.....	do.	IX	1
1	Fork.....	do.		
1	Knife.....	do.	VII	2
2	Magazines, pistol, extra if pistol is used.....	do.		
1	Meat can.....	do.	IX	1
1	Pistol or revolver.....	do.	VII	2
1	Pistol belt or revolver cartridge belt without saber ring.....	do.	IX	3
1	Pistol holster or revolver holster.....	do.		
1	Spoon.....	do.	IX	1
1	Pouch for first-aid packet.....	do.		
	Packet, first-aid (Medical Department.)	do.		
	Furnished by Quartermaster Corps—			
1	Identification tag.....	do.		
1	Shelter tent, half.....	do.		
1	Shelter-tent pole.....	do.		
5	Shelter-tent pegs.....	do.		
	(b) For each enlisted man individually mounted, in addition to (a)—			
1	Curry comb.....	Carried on horse.....	IX	5
1	Horse brush.....	do.		
1	Link.....	do.		
1	Saddle, McClellan, Field Artillery.....	do.	IX	2
1	Saddlebags, pairs.....	do.		
1	Spurs, pair.....	Carried on man.....		
1	Spur straps, set.....	do.	IX	5
1	Bridle, Field Artillery.....	Carried on horse.....		
	(c) For each driver, in addition to (a)—			
1	Currycomb.....	do.	IX	5
1	Horse brush.....	do.		
1	Spurs, pair.....	Carried on man.....	IX	2
1	Spur straps, set.....	do.		
	(d) For each cannoneer, not mounted, in addition to (a)—			
1	Can, condiment.....	do.	IX	1
1	Haversack, model of 1910.....	do.		

¹ Until these articles are supplied, the canteen, cavalry, and canteen strap, cavalry, may be used.² Saddles to be equipped with 1 stirrup gideon socket per battery.³ Until the model of 1910 haversack is supplied, the haversack, old model, and two canteen haversack straps may be used.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 caissons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	HORSE EQUIPMENT FOR EACH HORSE.			
1 1	Halter tie rope.....	Carried on horse.....	IX	
1 2	Halter headstall.....	do.....		
1	Feed bag.....	do.....		
1	Grain bag.....	do.....		
1 1	Saddle blanket.....	do.....		
1	Surcingle.....	do.....		
1	Horse cover.....	Not carried in field.....		
	SADDLER'S TOOLS.			
12	Awl blades, harness, assorted.....	In saddler's chest in battery wagon.....	X	
1	Awl, pegging.....	do.....		
1	Awl, seat, handled.....	do.....		
1	Carriage, pricking, 3 wheels.....	do.....		
1	Compass, 6 inch.....	do.....		
1	Creaser, double, lignum-vitae.....	do.....		
1	Claw tool.....	do.....		
1	Edge tool No 1.....	do.....		
1	Edge tool No 2.....	do.....		
2	Extra blades, with followers, for draw gage.....	do.....		
1	Gage, draw, brass.....	do.....		
1	Hammer, No 3, riveting.....	do.....		
1	Handle, peg, awl, with wrench.....	do.....		
2	Hafts, patent, awl, with wrench.....	do.....		
1	Knife, round.....	do.....		
1	Knife, splitting, 6-inch.....	do.....		
1	Needle case, leather.....	do.....		
1	Needle, glover's No 3, paper.....	do.....		
2	Needles, harness, No 4, papers.....	do.....		
2	Needles, harness, No 5, papers.....	do.....		
2	Needles, harness, No 6, papers.....	do.....		
12	Needles, sack-ing, assorted.....	do.....		
1	Nipper, cutting, 10-inch.....	do.....		
1	Oilstone, unmounted.....	do.....		
1	Pliers, 6-inch.....	do.....		
4	Punches, hand, round, assorted.....	do.....		
1	Punch, revolving.....	do.....		
1	Rivet set.....	do.....		
1	Rule, boxwood, 2-foot, 4 fold.....	do.....		
1	Screw driver, 3-inch blade.....	do.....		
1	Sewing palm, leather.....	do.....		
1	Shears, 10-inch bent trimmers.....	do.....		
1	Shoe knife, square point.....	do.....		
1	Shoe knife, broad point.....	do.....		
1	Slicker, steel.....	do.....		
2	Thimbles, aluminum-lined, steel.....	do.....		
	CARPENTER'S TOOLS.			
1	Bench ax.....	In carpenter's chest in battery wagon.....		
2	Bags, canvas, for small stores.....	do.....		
1	Bevel, 8-inch.....	do.....		
6	Bits, auger.....	do.....		
1	Bit, wood, countersink.....	do.....		
1	Bit, expansive, 2 cutters.....	do.....		
3	Bits, screw driver.....	do.....		
1	Brace, ratchet, 10-inch sweep.....	do.....		
3	Chisels, socket, framing.....	do.....		
1	Dividers, wing, 10-inch.....	do.....		
4	Drills, twist.....	do.....		
1	File, 10-inch, flat, bastard.....	do.....		
6	Files, saw, 4 and 6 inch (3 of each).....	do.....		
1	Gage, marking, brass, thumbscrew shoe and face.....	do.....		
2	Gauges, socket firmer.....	do.....		
1	Hammer, claw, adze eye.....	do.....		
1	Handle, tool, containing 10 tools.....	do.....		
2	Handles, file, aluminum alloy.....	do.....		
1	Knife, drawing, 9-inch blade.....	do.....		
1	Mallet, 2 $\frac{3}{4}$ by 5 inches, maple, hickory handled.....	do.....		
1	Nail set.....	do.....		
1	Oiler.....	do.....		

¹ Part of harness for all draft horses.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

War footing (4 how- itzers, 12 cais- sons).	Article.	Where carried.	Property classification.	
			Class.	Section.
	CARPENTER'S TOOLS—continued.			
1	Oilstone, unmounted.....	In carpenter's chest in battery wagon..		
1	Pincers, small, 8-inch.....	do.		
1	Plane, jack, wood.....	do.		
1	Plane, smoothing, wood.....	do.		
1	Plate, auger handle.....	do.		
1	Rasp, wood, 10-inch.....	do.		
1	Reamer, half round, for wood or soft metal.....	do.		
1	Rule, boxwood, 2-foot, 4 fold.....	do.		
1	Saw, crosscut, 24-inch.....	do.		
1	Saw, rip, 24-inch.....	do.		
1	Saw set.....	do.		
1	Screw driver, 5-inch blade, 10-inch.....	do.		
1	Spokeshave, adjustable.....	do.		
1	Square, steel, 12-inch body, 8-inch tongue.....	do.		
1	Tape line, linen.....	do.		
1	Vise, table, 2½-inch.....	do.		
1	Wrench, screw, 12-inch.....	do.		
	BLACKSMITH'S TOOLS.			
1	Anvil, 100-pound.....	In forge limber chest.....		
1	Aprons, blacksmith's.....	do.		
2	Bags, canvas, for nails.....	do.		
1	Box, shoeing, leather.....	do.		
1	Chisel, cold, 8-inch.....	do.		
1	Chisel, handled, for cold iron, 2 pounds.....	do.		
1	Chisel, handled, for hot iron, 1.5 pounds.....	do.		
1	Clinching iron.....	do.		
1	Cutting nipper, 14-inch.....	do.		
6	Drills, flat.....	do.		
1	File, flat, 12-inch, bastard.....	do.		
1	Fire rake.....	do.		
1	Fire shovel.....	do.		
1	Flatter, handled, 1.5-inch, square face.....	do.		
1	Fore punch and crease.....	do.		
1	Forge, Empire, portable.....	do.		
1	Hammer, hand, 2 pounds.....	do.		
1	Hammer, riveting, 1 pound 2 ounces.....	do.		
1	Hammer, shoeing, 10 ounces.....	do.		
1	Handle, file, aluminum.....	do.		
1	Hardie, 0.75 square shank, 1.25 bit.....	do.		
1	Oiler.....	do.		
1	Pritchel, 0.75 flats, 9-inch.....	do.		
1	Punch, round, 0.375-inch.....	do.		
1	Punch, round, 0.312 (1/8) inch.....	do.		
1	Punch, nail.....	do.		
1	Punch, square.....	do.		
1	Ratchet drill for square-shank drill.....	do.		
5	Rivet sets, 5 sizes.....	do.		
1	Rule, boxwood, 2-foot, 4 fold.....	do.		
1	Screw plates, taps and dies, with tap wrench, including chest.....	do.		
2	Shoeing knives.....	do.		
1	Shoeing pincers.....	do.		
1	Shoeing rasp, 16-inch.....	do.		
1	Sledge, 11-pound.....	In fasteners on foot rest.....		
1	Square.....	In forge limber chest.....		
1	Toe knife.....	do.		
1	Tongs, horseshoer's.....	do.		
1	Tongs for 0.25 iron.....	do.		
1	Tongs for 0.5 iron.....	do.		
1	Whetstone, farriers', 10-inch.....	do.		
1	Wrench, forge.....	do.		
1	Wrench, screw, 12-inch.....	do.		
	MATERIALS FOR CLEANING AND PRES- ERVATION (6 MONTHS' SUPPLY, ALL EXPENDABLE).			
5	Borax, pounds, lump.....	In store wagon.....		
1	Brush, camel's hair, No. 1, round.....	In chest for cleaning material, and small stores.....		
3	Brushes, sash, No. 3.....	do.		
3	Brushes, sash, No. 5.....	do.		

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

No.	Article.	Where carried.	Property classification.	
			Class.	Section.
	MATERIALS FOR CLEANING AND PRESERVATION (6 MONTHS' SUPPLY, ALL EXPENDABLE)—continued.			
1	Brush, varnish, No. 4-0.....	In store wagon.....		
2	Brushes, varnish, No. 5-0.....	do.....		
2	Brushes, varnish, No. 6-0.....	do.....		
2	Burners, lantern, Dietz, Vesta.....	In chest for cleaning material and small stores.		
2	Cloth, crocus, quires.....	1 quire in cleaning-material chest; the rest in store.		
1	Cloth, emery, No. ½, quire.....	In chest for cleaning material and small stores.		
1	Cloth, emery, No. 0, quire.....	do.....		
1	Cloth, emery, No. 00, quire.....	do.....		
2	Cosmic, No. 80, soft, quarts (1 quart cans).	In store wagon.....		
2	Chamois skins.....	In chest for cleaning material and small stores.		
3	Dressing, russet leather, boxes.....	do.....		
21	Eveready tungsten battery No. 793....	In cleaning-material and small-stores chest.		
6	Eveready 2.7V. Mazda bulb No. 1197..	In chest for cleaning material and small stores.		
2	Globes, lantern.....	In store wagon.....		
17	Lavaline, 16-ounce cans.....	5 pounds in store wagon; rest in store.		
25	Lye, powdered, cans, 1-pound.....	Not carried in field.....		
15	Naphthaline, pounds.....	In cleaning-material and small-stores chest.		
1	Oil, clock, ounce, 1-ounce bottles.....	In cans on store limber.....		
5	Oil, hydroline, gallons, 5-gallon cans...	In store wagon.....		
6	Oil, linseed, boiled, gallons.....	In cleaning-material and small-stores chest.	X	10
1	Oil, linseed, raw, pints.....	In store limbers.....		
15	Oil, lubricating, gallons.....	do.....		
20	Oil, neat's-foot, gallons.....	do.....		
5	Oil, slushing, light, gallons.....	do.....		
5	Oil, coal, gallons.....	do.....		
2	Oil, sperm, gallons.....	do.....		
75	Paint, olive-drab, second coat, pounds.	In store wagon.....		
75	Paint, olive-drab, third coat, pounds...	do.....		
5	Paint, rubberine, gallons, 1-gallon cans.	do.....		
5½	Petrolatum (vaseline), ounces (in tin box).	In cleaning-material and small-stores chest.		
17	Polish, Gibson's soap, 16-ounce cans...	In store at post.....		
6	Primer, brown enamel, quarts.....	20 pounds in cleaning-material and small-stores chest.		
75	Sal soda, pounds, bulk.....	In cleaning-material and small-stores chest.		
1	Sandpaper, No. 2½, quires.....	do.....		
1	Sandpaper, No. 1½, quires.....	do.....		
1	Sandpaper, No. ½, quires.....	do.....		
1	Sandpaper, No. 00, quires.....	do.....		
52	Soap, castile, pounds.....	In store wagon.....		
4	Soap, H and H, cakes or Paco.....	do.....		
80	Soap, saddle, Frank Miller's, pounds, 1-pound tins.	do.....		
65	Sponges, 5-inch.....	In store wagon, in hub liners.....		
10	Sponges, large size, 5½ or 6 inch.....	do.....		
8	Turpentine, gallons.....	In store wagon.....		
40	Waste, cotton, pounds, white.....	do.....		
5	Wicks, lantern, size 0.....	In cleaning-material and small-stores chest.		
	SADDLER'S MATERIAL (6 MONTHS' SUPPLY, ALL EXPENDABLE).			
6	Awl blades, harness, assorted.....	In saddler's chest.....	X	9
1	Awl haft, patent, No. 146, with wrench.	do.....		
2	Buckles, bar, 1-inch Saalbach, bronze..	In canvas bag for small stores, battery wagon.		
8	Buckles, bar, tongueless, ¾-inch, bronze	do.....		
13	Buckles, bar, tongueless, 1-inch, bronze	do.....		
5	Buckles, bar, tongueless, 1½-inch, bronze	do.....		
30	Buckles, center-bar, ¾-inch, bronze.....	do.....	X	10
6	Buckles, center-bar, ¾-inch, bronze.....	do.....		
9	Buckles, center-bar, ¾-inch, bronze.....	do.....		
2	Buckles, center-bar, 1-inch, bronze.....	do.....		
10	Buckles, center-bar, 1½-inch, M. I.....	do.....		

¹ Only one of these items will be issued to an organization.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

No.	Article.	Where carried.	Property classification.	
			Class.	Section.
	SADDLERS' MATERIAL (6 MONTHS' SUPPLY, ALL EXPENDABLE)—contd.			
10	Buckles, center-bar, 1½-inch, M. I.....	In canvas bag for small stores, battery wagon.		
7	Buckles, roller, ¾-inch, M. I.....	do.		
2	Buckles, roller, ¾-inch, M. I.....	do.		
15	Buckles, roller, ¾-inch, M. I.....	do.		
4	Buckles, roller, 1-inch, M. I.....	do.		
46	Buckles, roller, 1½-inch, M. I.....	do.		
3	Buckles, roller, 1½-inch, M. I.....	do.		
6	Buckles, satchel, ¾-inch, M. I.....	do.		
3	Buckles, wire, ¾-inch, bronze.....	do.	X	10
1	Buckles, wire, ¾-inch.....	do.		
24	Buckles, wire, ¾-inch.....	do.		
3	Buckles, roller, Royal, 1½-inch, M. I.....	do.		
3	Cheek "D".....	do.		
11	Conway loop, ¾-inch.....	do.		
20	Duck, cotton, olive drab, 22-inch, No. 1.....	do.		
12	End buckle, 1-inch, bronze, with clip.....	do.		
22	End clip, ¾-inch, bronze.....	do.		
12	End clip, 1-inch, bronze.....	do.		
21	End clip, 1½-inch, bronze.....	do.		
9	Foot staple, high, bronze.....	In saddler's chest.....	IX	5
18	Foot staple, low, bronze.....	do.		
9	Foot staple, semicircular.....	do.		
4	Hook, back strap, steel.....	In canvas bag for small stores, battery wagon.	IV	8
2	Hook, breast strap, steel.....	do.		
4	Hook, collar strap, steel.....	do.	IX	1
10	Hook, double, brass wire.....	In saddler's chest.....	IX	5
10	Hook, end, brass wire.....	do.	IV	8
2	Hook, side strap.....	In canvas bag for small stores, battery wagon.	IV	5
2	Hook, wire (for link), bronze.....	do.		
4	Leather, bridle, backs.....	In battery wagon.....		
5	Leather, collar, backs.....	do.	X	10
150	Leather, harness, backs, pounds.....	do.		
1	Leather, latigo, sides.....	do.		
8	Nails, saddle.....	In saddler's chest.....		
1	Needles, Glover's, No. 3, papers.....	do.	X	9
1	Needles, harness, No. 4, papers.....	do.		
1	Needles, harness, No. 5, papers.....	do.		
1	Needles, harness, No. 6, papers.....	do.		
8	Ornaments, brow band, copper.....	do.	IX	5
8	Ovals, saddle.....	do.		
3	Ovals, saddlebag.....	do.		
1	Pins, screw, brass, ¾-inch, No. 2, 1-gross packages.....	do.	X	10
6	Ring, ¾-inch diameter (saddlebag).....	do.	X	5
4	Ring (rifle scabbard), 1 inch diameter.....	do.	IX	5
18	Ring, 1½ inches diameter (saddle).....	do.		
3	Ring, 1½ inches diameter (back strap), M. I.....	do.		
5	Ring, 1¾ inches diameter (throat strap), M. I.....	do.		
3	Ring, 1¾ inches diameter (breecching), M. I.....	do.		
10	Ring, 2 inches diameter (halter), M. I.....	Small-stores bag, battery wagon.....		
6	Ring, 4 inches diameter (quarter strap).....	do.		
8	Ring D, 1 inch diameter (feed bag), M. I.....	In saddler's chest.....		
6	Ring D, 1½ inches diameter, with clasp, steel.....	do.		
3	Ring D, 1¾ inches diameter, steel.....	do.	X	10
3	Ring D, 2 inches diameter (special), steel.....	do.		
1	Rivets and burs, brass, ¾-inch, No. 12, pounds.....	do.		
1	Rivets and burs, brass, ¾-inch, No. 10, pounds.....	do.		
1	Rivets and burs, brass, ¾-inch, No. 10, pounds.....	do.		
1	Rivets and burs, brass, 1-inch, No. 8, oval heads, pounds.....	do.		
3	Rollers, lead rein steel.....	do.		
600	Rope, ¾-inch (halter), feet, manila hemp.....	In battery wagon.....	IV	8
1	Screws, brass, 1-inch, No. 6, wood, gross.....	In saddler's chest.....	IX	10
10	Sheep skins, with wool on.....	In battery wagon.....		

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

No.	Article.	Where carried.	Property classification.	
			Class.	Section.
	SADDLERS' MATERIAL (6 MONTHS' SUPPLY, ALL EXPENDABLE)—contd.			
1	Shield, saddle, 11-inch.....	In saddler's chest.....	IX	5
1	Shield, saddle, 11½-inch.....	do.....		
3	Shields, saddle, 12-inch.....	do.....		
3	Snap hook, canteen, Cavalry.....	do.....		
2	Snap hooks, coverts, ¾-inch, M. I.....	do.....		
2	Snap, covert, 1-inch, M. I.....	do.....	X	10
2	Snap, German, ¾-inch, M. I.....	do.....		
5	Snap hook, haversack, 1-inch.....	do.....	IX	1
5	Snap swivel, 1-inch, No. 16.....	do.....	X	10
8	Snap, German, 1-inch, M. I.....	do.....		
28	Square, halter, M. I.....	In canvas bag for small stores, battery wagon.		
2	Strap loop, coupling, ¾-inch (for bridle).....	do.....	IX	5
8	Strap loop, feed bags.....	do.....		
3	Stud hook.....	do.....		
5	Studs, saddlebag.....	In saddler's chest.....	IX	5
1	Tacks, copper, No. 12, ½ lb., paper.....	do.....		
1	Tacks, copper, No. 20, ½ lb., paper.....	do.....	X	10
1	Thimble, aluminum lined, steel, size ¾ inch.	do.....		
1	Thread, carpet, No. 18, olive-drab, pound.	do.....		
1	Thread, shoe, No. 3, brown, pounds.....	do.....		
1	Thread, shoe, No. 10, brown, pounds.....	do.....		
2	Wax, stitching, brown, winter, pounds.....	In battery wagon.....	X	10
16	Webbing, olive-drab, cotton, heavy, ¾-inch, yards.	do.....		
28	Webbing, olive-drab, cotton, heavy, 1-inch, yards.	do.....		
11	Webbing, olive-drab, halter, 1½-inch, yards.	do.....		
14	Webbing, jute, 3½-inch, yards.....	do.....		
FOR POLO EQUIPMENT.				
2	Buckles, wire, ¾-inch.....	In saddler's chest.....		
2	Buckles, wire, ¾-inch.....	do.....		
12	Buckles, wire, ¾-inch.....	do.....		
4	Buckles, wire, ¾-inch.....	do.....		
2	Buckle, nickel plated, stirrup strap, 1½-inch.	do.....		
6	Buckle, nickel plated, girth, 1-inch.....	do.....		
4	Ring, ¾-inch diameter.....	do.....		
5	Web, linen straining, 3½-inch, yards.....	In battery wagon.....		
7	Webb, linen, straining, 5-inch, yards.....	do.....		
RESERVE SUPPLIES FOR WAR SERVICE. ¹				
Ammunition. ²				
3	Buckles, bar, tongueless, ¾-inch.....	In store.....		
5	Buckles, bar, tongueless, 1-inch.....	do.....		
10	Buckles, center bar, ¾-inch.....	do.....		
3	Buckles, center bar, ¾-inch.....	do.....		
3	Buckles, center bar, ¾-inch.....	do.....		
3	Buckles, center bar, 1½-inch.....	do.....	X	10
3	Buckles, center bar, 1½-inch.....	do.....		
2	Buckles, roller, ¾-inch.....	do.....		
5	Buckles, roller, ¾-inch.....	do.....		
12	Buckles, roller, 1½-inch.....	do.....		
10	Buckles, wire, ¾-inch.....	do.....	X	10
2	Burners, lantern.....	do.....		
1	Cheek "D".....	do.....		
1	Chamois skin.....	do.....		
4	Conway loops, ¾-inch.....	do.....		
3	Dressing, russet leather.....	do.....	IV	8
4	End buckles.....	do.....		
2	Globes, lantern.....	do.....		
2	Hooks, back strap.....	do.....		
2	Hooks, collar strap.....	do.....		
3	Hooks, double, brass wire.....	do.....	IX	1
3	Hooks, end, brass wire.....	do.....	IX	5
2	Leather, bridle, backs.....	do.....	X	10
2	Leather, collar, backs.....	do.....		

¹ No material will be drawn from this supply for making repairs and replacements except in sudden calls for field service, if necessary to replace missing items of the regular supplies. To avoid deterioration, all perishable articles should be replaced by similar ones received with the regular 6 months' allowance.

² See general orders pertaining to annual allowance of.

STATEMENT OF TOTAL EQUIPMENT OF ONE 3.8-INCH HOWITZER BATTERY—Contd.

No.	Article.	Where carried.	Property classification.	
			Class.	Section.
	RESERVE SUPPLIES FOR WAR SERVICE—continued.			
30	Leather, harness, pounds.....	In store.....	X	10
1	Leather, latigo, side.....	do.....		
3	Nails, saddle.....	do.....		
1	Oil, clock, ounce.....	do.....	IX	5
4	Oil, coal, gallons.....	do.....		
4	Oil, hydroline, gallon.....	do.....		
12	Oil, lubricating, gallons.....	do.....	X	10
16	Oil, neat's-foot, gallons.....	do.....		
2	Oil, slushing, light, gallons.....	do.....		
1	Oil, sperm, gallon.....	do.....	IX	5
3	Ornaments, brow band.....	do.....		
2	Rings, $\frac{7}{8}$ -inch diameter, saddlebag.....	do.....		
8	Rings, $1\frac{1}{4}$ -inch diameter, saddle.....	do.....	IV	8
4	Rings, 2-inch diameter, halter.....	do.....		
3	Rings, 4-inch diameter, cincha strap.....	do.....		
3	Rings, 4-inch diameter, quarter strap.....	do.....	X	10
3	Rings "D" 1-inch diameter, feed bag.....	do.....		
1	Rivets and burs, brass, $\frac{1}{4}$ -inch, No. 10, pound.....	do.....		
1	Rivets and burs, brass, $\frac{1}{8}$ -inch, No. 10, pound.....	do.....	IX	1
18	Sal soda, pounds.....	do.....		
2	snap hooks, haversack, 1-inch.....	do.....		
3	Snap hook, feed bag.....	do.....	IV	8
12	Squares, halter.....	do.....	IX	5
40	Soap, castile, pounds.....	do.....	X	10
3	Soap, H. and H., cakes or "Paco".....	do.....		
60	Soap, saddle, Frank Miller's, pounds.....	do.....		
25	Sponges, 5-inch.....	do.....	IV	8
2	Strap loops, feed bag.....	do.....		
2	Studs, saddlebag.....	do.....		
1	Tacks, copper, 12-ounce, paper.....	do.....	IX	5
1	Tacks, copper, 20-ounce, paper.....	do.....		
1	Thread, carpet, No. 18, olive-drab, pound.....	do.....		
1	Thread, shoe, No. 3, brown, pound.....	do.....	X	10
1	Thread, shoe, No. 10, brown, pound.....	do.....		
25	Waste, cotton, pounds.....	do.....		
1	Wax, stitching, brown, pound.....	do.....	IX	5
2	Wicks, lantern.....	do.....		

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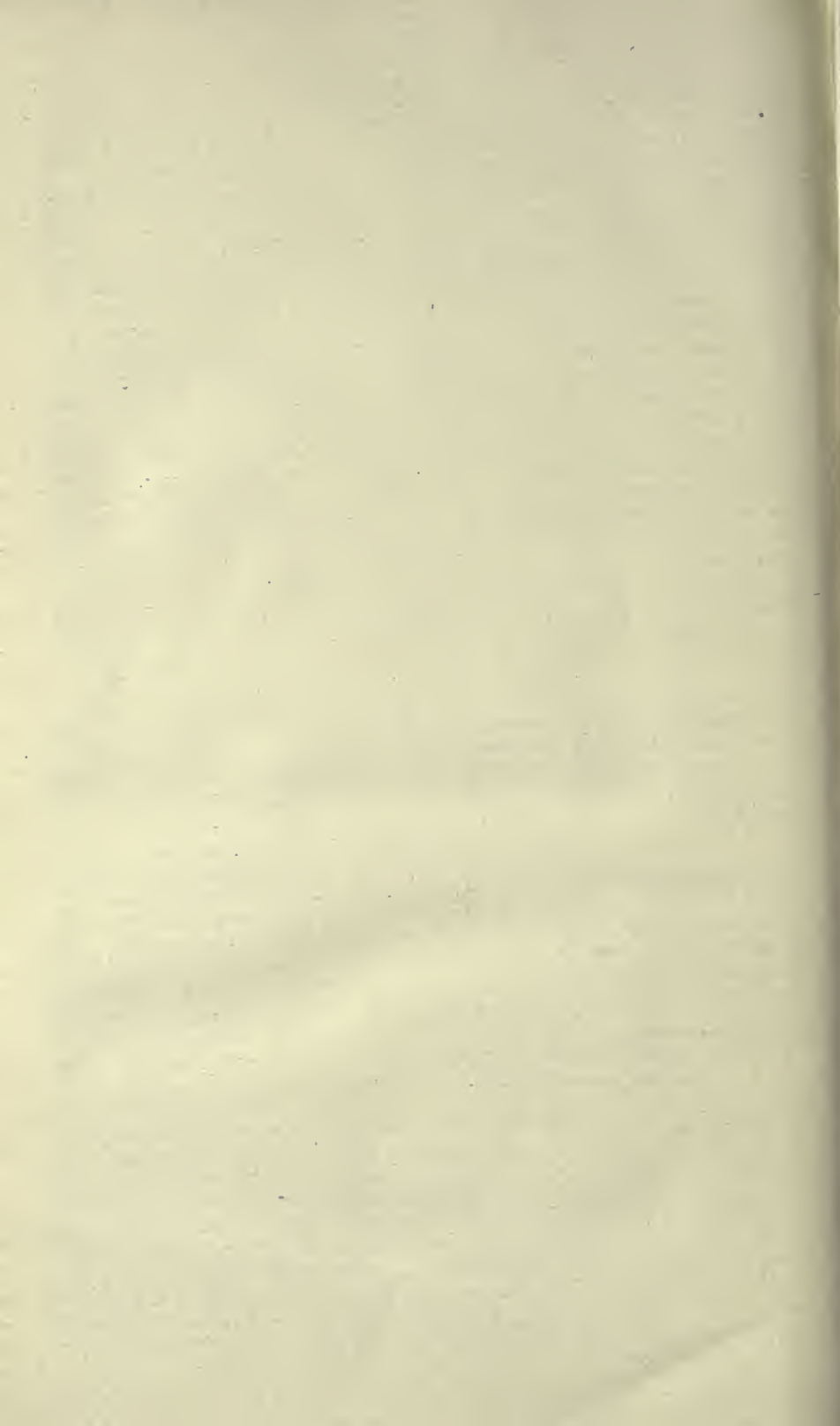
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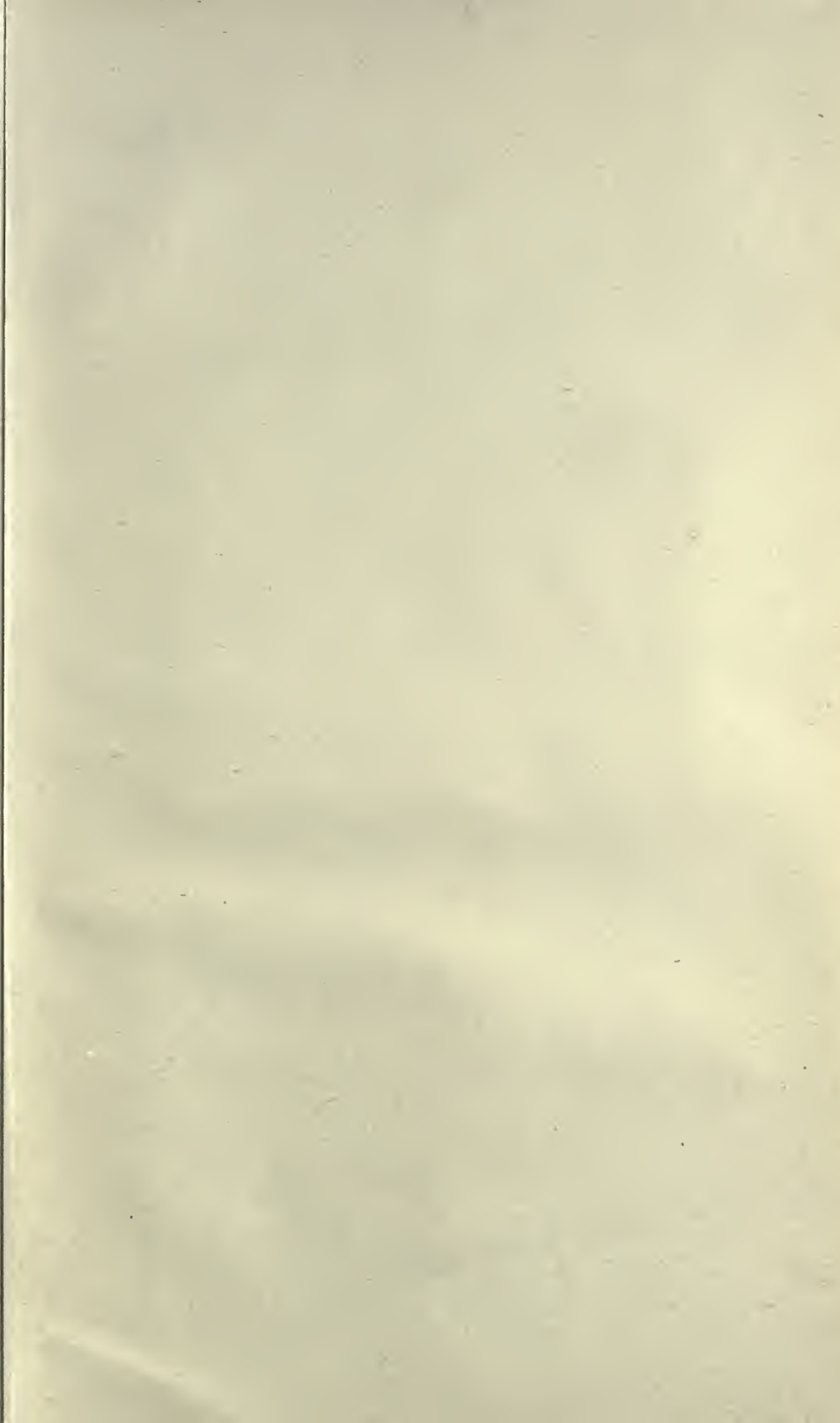
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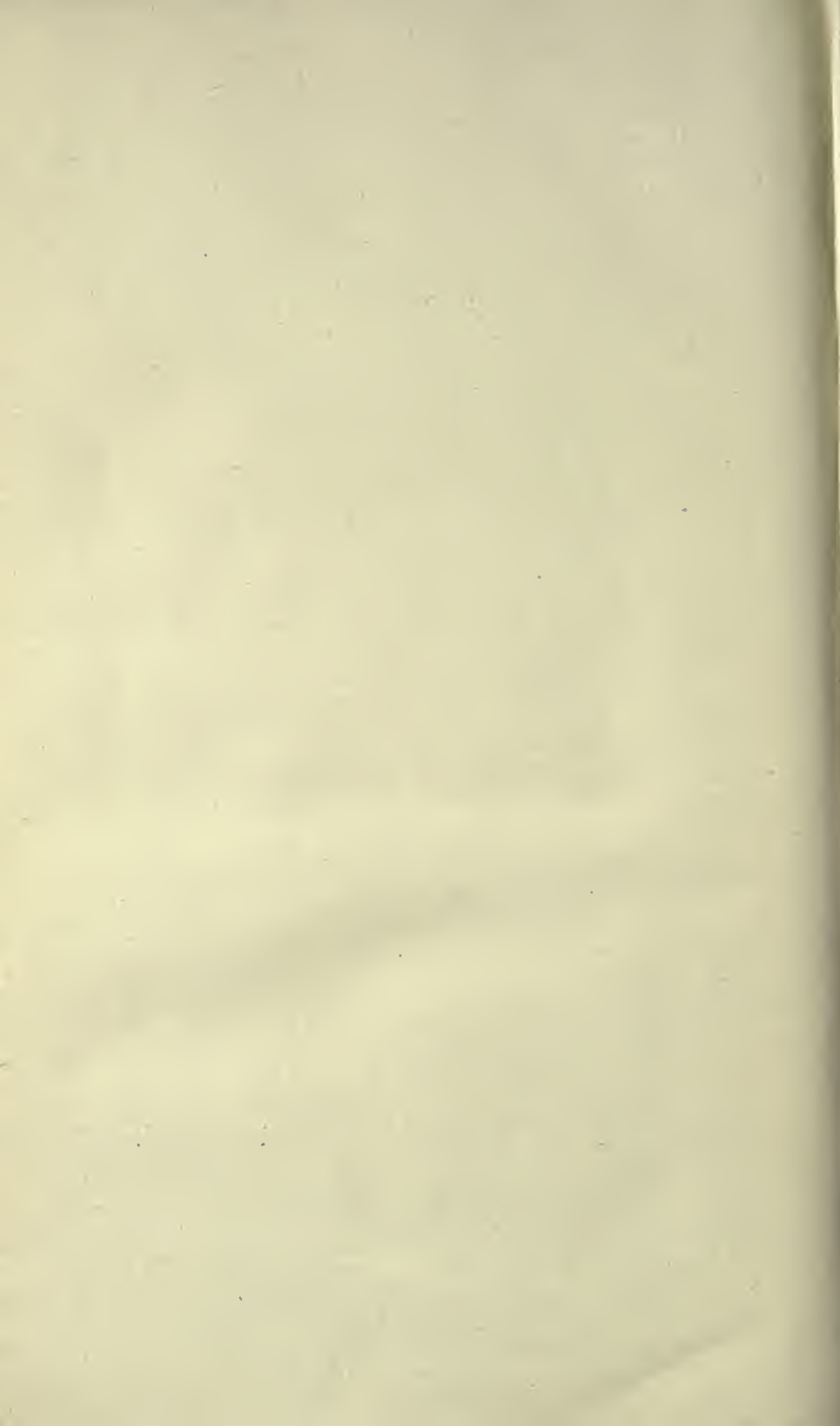
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